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MEMOIRS

OF THE

Royal Society;

Or, a New ABRIDGMENT of the

Philoſophical Tranſactions.

Giving an ACCOUNT of the Undertakings, Studies, and Labours of the LEARNED and INGENIOUS in many conſiderable Parts of the World; from the firſt Inſtitution of that ILLUSTRIOUS SOCIETY in 1665, to 1740.

In the Courſe of this WORK, every Thing is carefully extracted from the ORIGINALS, according to the Order of Time; the LATIN TRACTS Engliſhed; the Terms of ART explained; the Theoretical PARTS applied to Practice; and the whole Illuſtrated with a great Number of COPPER PLATES.

A PERFORMANCE of general Uſe for the Knowledge and Improvement of MATHEMATICKS, NATURAL PHILOSOPHY, TRADES, MANUFACTURES, ARTS, *&c.*

By Mr. BADDAM.

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MEMOIRS
OF THE
ROYAL SOCIETY;

Being a New ABRIDGMENT of the

PHILOSOPHICAL TRANSACTIONS.

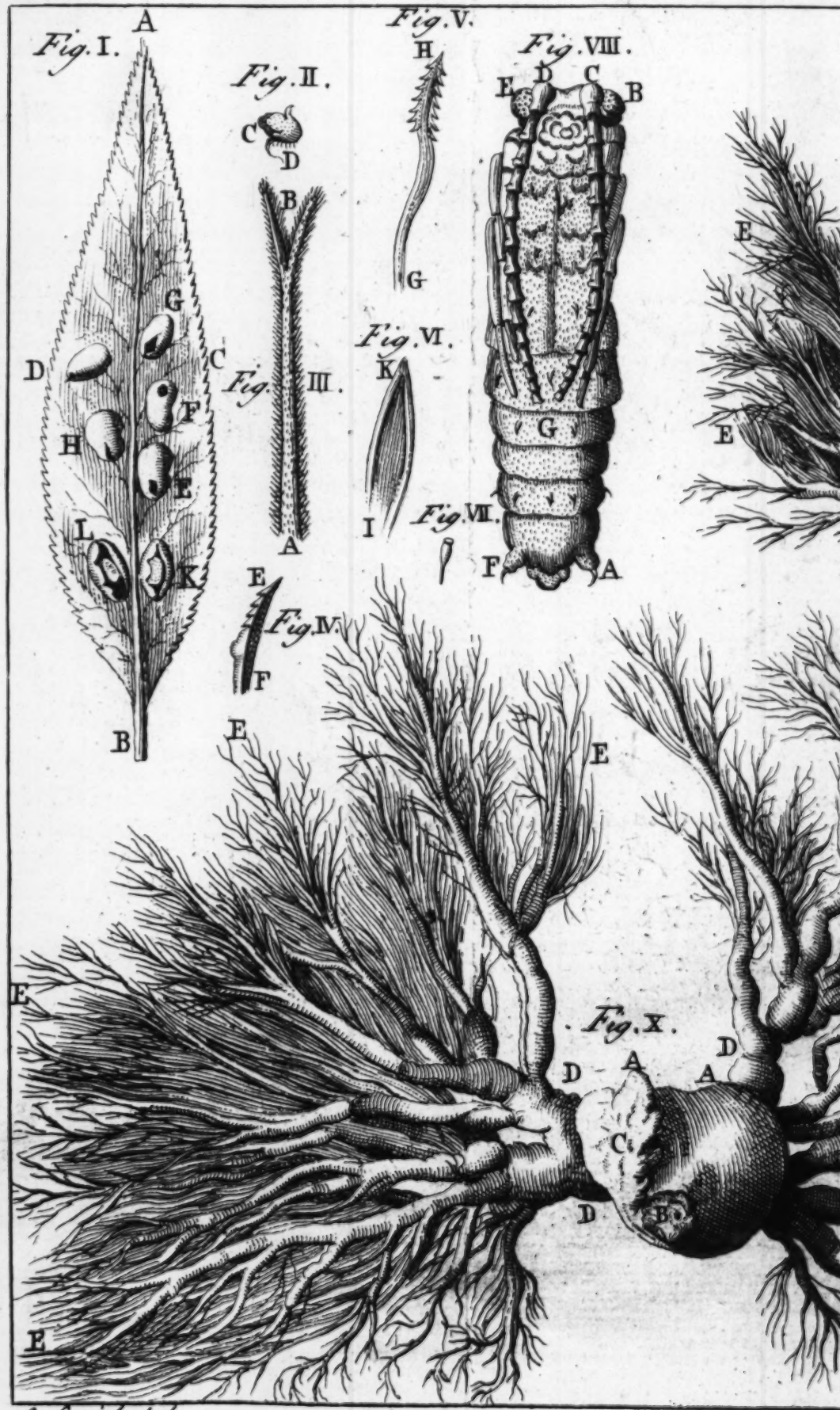
Excreſcencies *growing on* Willow-trees, *&c. by M.* Leewenhoeck. Phil. Tranſ. N° 269. p. 786.

M. *Leewenhoeck* took the largeſt and greeneſt willow-leaves, and having opened the knotty part which is found in ſome of them, he frequently diſcovered therein more than one ſort of worms; but none of them being full grown, he cut off ſome of thoſe knots, and opened one a little, he ſaw a worm therein and he ſhut it together again; having put ſeveral of theſe knots into a large glaſs-tube, that the worms might attain their full growth, he could not find that any of them did ſo; he obſerved at the ſame time, that ſeveral of theſe knots had no worms in them, but were almoſt full of the excrements of the worms that had been therein, and were diſlodged thro' a ſmall hole, which he could perceive in the knots.

Plate, I. Fig. 1. ABCD repreſents the leaf of a willow-tree, in which are ſeven knobs or tumours, ſome of them with holes as EFG; another as H; I ſhows the poſture of the worm, as it lay in the knob M. *Leewenhoeck* diſſected; he further obſerved, that ſeveral of the worms lay dead in the knobs,

and conſidering what ſhould be the reaſon thereof, he was at laſt aware that there was a ſmall worm linked faſt to the great one, which ſmall one had no conveniency of getting out, being at both ends of a pointed form, but chiefly in the hinder part; its mouth was ſcrewed into the body of the great worm, from whence he ſeemed to M. *Leewenhoeck* to fetch his nouriſhment, and by that means occaſioned the other's death; M. *Leewenhoeck* ſuppoſes, that if nature had not made this ſort of proviſion for theſe animals, they could not ſubſiſt, having no feet nor claws proper to faſten on the leaves of trees; how theſe laſt worms got into the cavities of thoſe tumors, M. *Leewenhoeck* was at a loſs; but let us ſuppoſe that the firſt or great worm is produced from an egg, which ſome fly has laid on a willow-leaf, and that this worm having eat its way thro' the veſſels of thoſe leaves, a ſort of viſcous matter iſſued therefrom, which intangled the worm, and being dried up together, produced ſuch knobs in the leaves, which incloſed the worms; now ſome time after, a leſſer ſort of fly happened to pitch upon the ſame knob, and made a hole therein, where it laid its eggs, from whence proceeded the above-mentioned little creature, which devoured and lived upon the large worm; in the middle of *July* M. *Leewenhoeck* cropt ſeveral willow-leaves, in which were ſuch like knobs; with theſe he proceeded, as with the former, and diſcovered ſeveral worms, that were nearly arrived at their full growth: After theſe knobs had been in the glaſs-tube about 8 days, he opened one of them, and ſaw that the worm was turned into a *Tonnekin* or *Aurelia*, and opening ſome others, he took out 13 or 14 more *Tonnekins*; in ſome of the knobs he found the ſmall devouring worms above-mentioned, he calls them devouring, becauſe they prey upon a worm at leaſt 50 times bigger than themſelves; they were ſo far advanced in growth that without uſing any more food, they were ready to be changed into flying inſects, which he alſo put into the glaſs-tube: M. *Leewenhoeck* imagined that theſe *Tonnekins* were of the ſame make and texture with that of our ordinary flies; that is, when any of thoſe worms are near their change their ſkin is contracted, ſo as to ſtick cloſe to their body, and this they call a *Tonnekin*, without making any web, as happens to ſome ſorts of inſects; theſe *Tonnekins* were of a darkiſh red colour; when M. *Leewenhoeck* opened one of them, he found the worm lying entire as it was, tho' it had been incloſed in its pellicle or ſhell above 14 days; but upon viewing ſome part of the *Tonnekin* with a microſcope, he found he was deceived, and that it did not conſiſt either of the web or ſkin of the ſaid worm, he inclined to believe, that it was rather a part of the leaf itſelf,

the


Fig. I.
A
G
D
C
F
H
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L
K
B
Fig. II.
C
D
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Fig. III.
A
Fig. IV.
E
F
Fig. V.
H
G
Fig. VI.
K
I
Fig. VII.
F
Fig. VIII.
E
D
C
B
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A
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Fig. X.
D
A
A
D
C
D
B

G. Smith del.

Fig. XI.

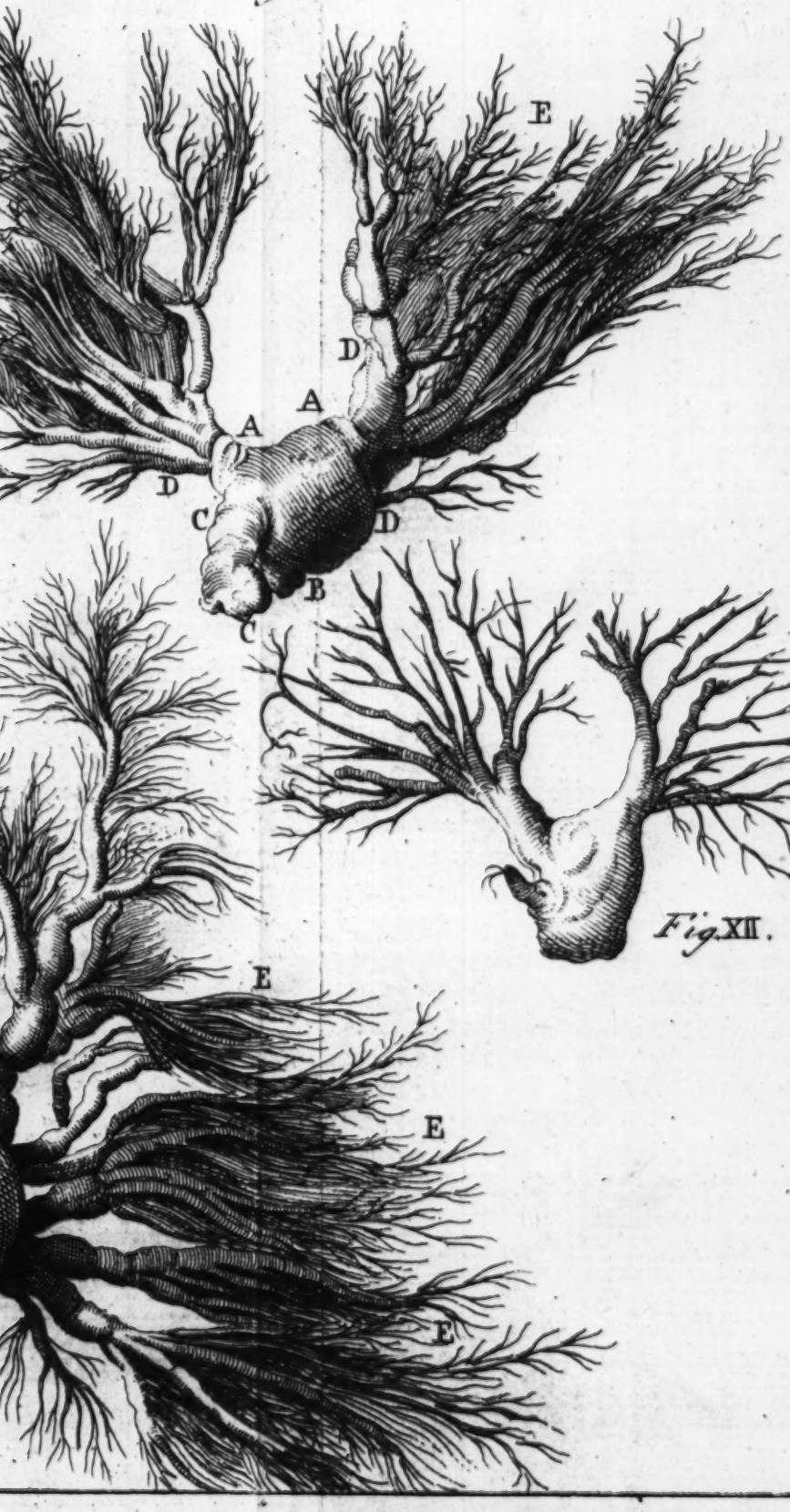
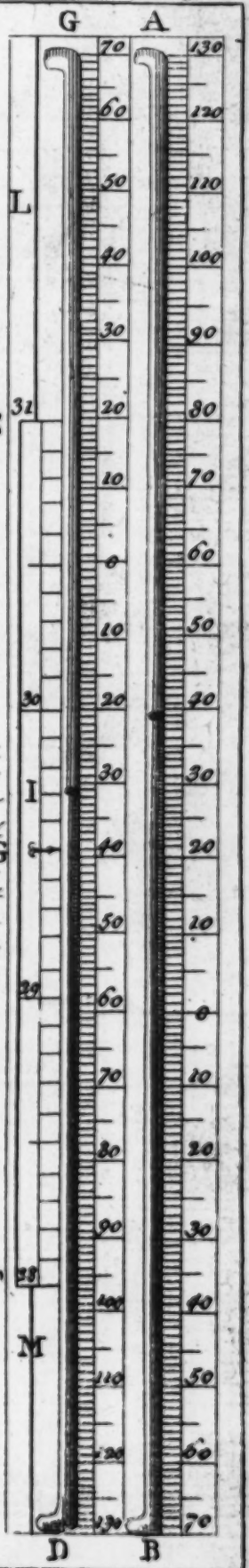


Fig. XII.

Fig. IX.



Hulett Sculp

the microſcope repreſenting its parts like branches, from whence proceeded ſmaller ſprigs; and further, tho' he opened ſeveral of thoſe knobs before-mentioned, he did not find one *Tonnekin* therein, excepting in ſuch as he had put in the glaſs-tube: After ſome weeks, he perceived certain black flies, proceed from thoſe *Tonnekins*, the hinder parts of their body being of an oblong figure, and faſhioned like a hook; the others could not arrive to maturity, but having made a ſmall opening in their pellicle, they juſt put their heads out, and ſo died; from the ſame *Tonnekins* proceeded a ſecond ſort of fly, ſmaller than the former, and not ſo pointed at the extremity: M. *Leewenhoeck* ſaw two of theſe ſmall worms (which devoured the large ones) endeavour to ſhut themſelves up in a web; but by reaſon of the large ſpace, wherein they lay, they could not bring it quite round them, having made it only on one ſide; but their change happened in ſo ſhort a time, that he could not make remarks thereon, and as the moths, ſilk-worms, *&c.* lie very regularly in a ſort of pellicle or membrane with their legs and wings after their change, ſo in like manner lay the horns and feet of theſe little animals, each in a particular pellicle, but ſeparate from the body, and after the ſame manner lay the hinder part of their body, which was ſhaped much like a hook: Theſe *Tonnekins*, which at firſt were white, in a few days became blackiſh, and at laſt produced that kind of fly with the abovementioned inſtrument in its hinder part like a hook, which in length amounted to near two thirds of the whole body.

Fig. 2. repreſents the aforeſaid fly, juſt as it appeared to the naked eye, CD ſhews the long, ſlender and hooked part; when M. *Leewenhoeck* brought this little inſtrument before the microſcope, it ſeemed a ſort of hook, for it was covered with a great number of fine hairs, as you may ſee in Fig. 3. and it appeared to M. *Leewenhoeck* to be hollow, upon which imagining it might not rather be the caſe for a hook, he endeavoured to ſplit it, and the hook itſelf appeared, whoſe point is only delineated, jagged with teeth like a ſaw, EF Fig. 4. the more M. *Leewenhoeck* viewed this hook, the more he fancied there was another incloſed therein, upon which ſplitting the firſt hook, he took out two other diſtinct hooks, of one and the ſame ſhape; a ſmall part of one of them is repreſented by GH Fig. 5. each hook was fortified with teeth like ſaws, which he obſerved was peculiar to them; when he had taken theſe hooks out of Fig. 4. he was convinced, that that which he took for a hook, was only a ſecond caſe or ſheath for the other two, as may be ſeen by IK Fig. 6. wherein the hollowneſs does likewiſe plainly appear; and there is alſo a

cavity

cavity to be obſerved in Fig. 5. which M. *Leewenhoeck* ſuppoſes might contain a ſharp poiſonous liquor.

From this diſcovery, it is eaſy to conceive, that ſuch flies do not only lay their eggs on the leaves of trees, but that they alſo make an aperture in the ſkin of the leaf, and convey an egg into it, from whence comes the worm, which gnawing the veſſels for its ſuſtenance, occaſions the ſap to flow out of them, and coagulate into that knotty ſubſtance; beſides, one ſmall fly produced one of theſe worms, whoſe hinder part was alſo hooked, much like that ſpecies of flies that proceed from the worms on currant-trees. M. *Leewenhoeck* took two *Tonnekins* out of the abovementioned knobs in willow-trees, no bigger than grains of coarſe ſand, in order to deſcribe the ſhape of ſuch a ſmall animal, but in three hours after he miſſed them, and concluded, that in that time they were turned to flies and got away; he alſo took dead worms out of the ſaid knobs, but could not find the leſſer ſort of worm that uſe to devour the other, only he obſerved two oblong white particles upon the dead worm, which were ſo very ſmall, that they eſcaped his naked eye; he ſuppoſed they were eggs, for he could obſerve nothing that reſembled a worm, and the third day there plainly appeared two worms exactly of the ſame ſize and ſhape with thoſe that devour the larger ones; he took a ſmall devouring worm from a larger that lay dead by it, and from that it took its nouriſhment, and put it upon a living one, upon which it immediately faſtened, whilſt the other at the ſame time uſed all means, by bending, ſtretching, contracting, and winding its body, to free itſelf from this troubleſome gueſt, but in vain, the ſmall worm ſtill keeping its hold; and when it is arrived at its full growth, it is exactly repreſented in Fig 7.

Fig. 8. A B C D E F repreſents a *Tonnekin* which but the evening before had been a worm, and which had caſt a very thin ſkin; and as the body of the worm conſiſted of ſo many rings, or circles, ſo likewiſe did the *Tonnekin*: In this M. *Leewenhoeck* not only obſerved the feet, but even the joints thereof; C G and D G repreſent its two horns, and tho' they were incloſed in a thin membrane, yet he could clearly ſee all the joints, which were looſe from the body, excepting only at the head; this worm, both before and after its change into a *Tonnekin*, is very white, and ſome days after the eyes appear of a browniſh colour: M. *Leewenhoeck* often endeavoured to watch the change of theſe worms, but it is ſo ſudden, that he could never do it: M. *Leewenhoeck* obſerved that the mites in cheeſe turn into *Tonnekins*, and from thence into flies; and farther, when they turn into *Tonnekins*, they lie

lie incloſed in a thin tranſparent membrane; now this pellicle that covers the *Tonnekin*, is a great defence for the worm within it, which not being able to ſhut itſelf up in a web (as ſeveral other inſects do, before their approaching change, that they may not be devoured by their enemies) without ſuch a pellicle would certainly become a prey to the maggots that ſwarm in cheeſes: M. *Leewenhoeck* obſerved that ſome of the flies produced from cheeſe-worms, which he kept in a glaſs, and therein put cheeſe for them to feed upon, had coupled; and ſoon after, all of them laid eggs of an oblong figure, and then died; from theſe eggs came young worms, which alſo fed on the cheeſe, and when he judged them to be at their full growth, and the weather began to be cold, he took ſix of the biggeſt, and carried them about him, and a few days after, he obſerved that four were changed into *Tonnekins*, that two worms were dead, and two flies were ſkiping about the glaſs; he tried the ſame thing in *January*, and with the like ſucceſs; whilſt he kept them in the cold, there was little or no ſign of life, or motion, but as ſoon as he put them into his pocket, they were as briſk as in ſummer; he opened a *Tonnekin* that had never produced a fly, and found a dead one within it, which had been making its efforts to get out, but was not ſtrong enough to effect it.

The Diſſection of a Woman *who died in Child-bed; by Dr.* Peter Sylveſter. Phil. Tranſ. N° 262. p. 717. *Tranſlated from the* Latin.

M. *Duchenſe* about 40 years of age, was of a plethoric conſtitution, and had very frequently her *Menſes* upon her, even when big with child, but was otherwiſe very healthful and jolly; having now gone with the twentieth child, when her time drew near, ſhe was ſiezed about 4 o'clock in the afternoon with an extraordinary hemorrhage; M. *James Arnaudin* both a ſkilful man-midwife and ſurgeon, being ſent for after 9 o'clock, and being told of this flux of blood, he thought no remedy would be of any ſervice in ſuch a dangerous caſe, before the patient was delivered; after that the patient's ſtrength being quite ſpent, M. *Arnaudin* was again ſent for about midnight, who without any further delay, extracted in leſs than half an hour a dead female child, the *Secundines* were diſcharged with eaſe and were both ſound and entire; yet the hemorrhage ſtill continued, which was ſucceeded by a low pulſe, frequent fainting fits, a cold ſweat and convulſions; at length about 9 o'clock next morning ſhe died; the following day M. *Arnaudin* opened the *Abdomen*, and

and upon removing both the *Omentum* which was very fat, and the ſmall inteſtines, the *Uterus* appeared like a large cupping-glaſs, very thick and much diſtended; there was a great *Ecchymoſis* in the right broad ligament, which deſcended from the ſide of the *Uterus*, where the ſpermatic and hypogaſtric veſſels are united by an *Anaſtomoſis*, and was moſt obſerveable in the inferior part of the neck of the *Matrix*, where it lies upon the *Rectum*: M. *Arnaudin* having cut out the *Uterus* with all its parts, and extracted it out of the *Pelvis*, he laid it on a table; the *Vagina* was very lax, and its internal orifice was ſo open, as that it could readily receive half the fiſt; the *Uterus* being cut lengthwiſe, its bottom was full of ſome grumous blood, but in other reſpects ſound and entire; and here he could plainly ſee the adheſion of the *Placenta*, where the internal ſubſtance of the *Uterus* was obſerved to be unequal, thicker and as it were more fleſhy; in the lower part of the neck of the *Uterus* appeared the cauſe of the patient's death; *viz.* a dilaceration two fingers breadth, which could be ſeen externally where the *Ecchymoſis* was; but whether the *Uterus* was dilacerated by any external cauſe, or rather by the ſtruggling of the child, as phyſical writers mention ſometimes is the caſe, M. *Arnaudin* could not tell; but it is certain, that it was from that part that the large veſſels diſcharged that vaſt quantity of blood; upon ſeparating the coats, and putting a blow-pipe between the duplicature, the blaſt iſſued out at ſeveral ſmall holes, both from that part of the bottom of the *Uterus* to which the *Placenta* was connected, but eſpecially from the dilacerated part of its neck: M. *Arnaudin* could plainly ſee the *Cicatricula* in the right ovary, from which, he did not queſtion, but an egg had dropped into the cavity of the tube, which was conveyed by its periſtaltic motion into the *Uterus*; the left ovary was flaccid, and exſuccous, the tubes were open on both ſides; the round ligaments were ſtrong, and all other things were obſerved to be ſound: Tho' the *Uterus* be ſuddenly contracted after child-bearing, ſo that, as M. *Arnaudin* has juſt now mentioned in this woman, who died about 6 hours after her delivery, it ſcarce exceeded the bulk of a large cupping-glaſs; yet with his fingers he could eaſily ſtretch it out like a bag; and indeed it is evident that the fleſhy fibres being by degrees ſo much diſtended and ſo far ſeparated from each other in the time of the pregnancy, could not for ſome time after, recover their priſtrine tone and ſtrength.

M. *Arnaudin* obſerves by the bye, that the queſtion commonly put amongſt anatomiſts, is almoſt about nothing; *viz.* whether the coats of the *Uterus* be thicker in pregnancy, than they are

are in their natural ſtate? M. *Arnaudin* allows indeed, that the ſubſtance of the *Uterus* of women not with child, is firmer, thicker and more compact, ſeeing the fleſhy fibres are then ſhortened and very much contracted; but in women with child, the *Uterus* is much more lax, by reaſon of the extenſion of its fibres, and their greater diſtance from each other; beſides, ſeeing the blood-veſſels, whoſe ſpiral ramifications in their natural ſtate reſemble vine-tendrils, creep along the ſides and bottom of the *Uterus*, in the time of pregnancy, they are together with it extended, and ſo ſeparated from each other; hence it is, that the coats appear thinner; but the ventricle, bladder, and other membranous parts, become thinner by expanſion, and why the ſame ſhould not hold good as to the *Uterus* is plain; for in whatever proportion its coats are extended, in the very ſame proportion is the great number of its ſeveral veſſels enlarged, and dilated for the nouriſhment and growth of the *Fœtus*; beſides, the internal ſubſtance of the *Uterus*, which is perforated with a great many ducts is at that time thicker, and chiefly ſo, at its bottom where the *Placenta* adheres; and this is alſo very manifeſt in animals that have cotyledons; the occaſion of the miſtake, M. *Arnaudin* takes to be this; *viz.* that opening the body ſoon after delivery, at which time the *Uterus* is contracted, and its veſſels ſwelled and diſtended with blood, anatomiſts might hereby be led to think that the coats of the *Uterus* in pregnant women were twice as thick as they are in their natural ſtate.

That peculiar diſtribution of the blood-veſſels in the *Uterus*, which M. *Arnaudin* has mentioned above, is very obſervable; for the ſpermatic and hypogaſtric arteries and veins are curiouſly curled, and contorted, like ſo many vine-tendrils, on the bottom, and ſides of the *Matrix*; hence they may be extended not only in the ſame manner as the *Uterus*, but alſo in the latter months of pregnancy, when they approach nearer to a right line, the blood is more eaſily conveyed and diſtributed thro' them; and how much this contributes to ſupply that quantity of nutritious juice, which is requiſite to nouriſh the *Fœtus* when advanced in growth, would be ſuperfluous to farther explain.

An Account of Dr. Hook's Marine Barometer *by Mr.* E. Halley. Phil. Tranſ. N° 269. p. 791.

DR. *Hook*, who has made ſeveral attempts to improve the mercurial barometer, and render the minute diviſions on the ſcale thereof more ſenſible, judging that it might be of great uſe at ſea, contrived ſeveral ways to make it ſerviceable

aboard ſhip: The mercurial barometer, requiring a perpendicular poſition, and the quick-ſilver vibrating therein with great violence upon any agitation, is therefore unfit to be uſed at ſea: It is about 40 years ſince, that the thermometer of *Robert de Fluctibus*, depending on the dilatation and contraction of included air by heat and cold, has been diſuſed, upon diſcovering that the preſſure of the air is unequal; that inequality mixing itſelf with the effects of the warmth of the air in that inſtrument; and inſtead thereof was ſubſtituted the ſealed thermometer, including ſpirits of wine (firſt brought from *Italy* into *England* by Sir *Rob. Southwell*) as a proper ſtandard of the temper of the air, in relation to heat, and cold; that æthereal ſpirit being of all others, that are yet known, the moſt ſuſceptible of dilatation, and contraction, eſpecially with a moderate degree either of heat or cold; now this being allowed as a ſtandard, and the other thermometer that includes air, being graduated with the ſame diviſions, ſo as at the time when the air was included, to agree with the ſpirit-thermometer in all the degrees of heat and cold, obſerving at the ſame time the preciſe height of the mercury in the common barometers; it will readily be underſtood, that whenever theſe two thermometers ſhall agree, and the preſſure of the air is the ſame it was when the air was included, and the inſtrument graduated; that if in the air-thermometer, the liquor ſtand higher, than the diviſion mark'd thereon, correſponding with that on the ſpirit-glaſs, it is an indication that there is a greater preſſure of the air at that time, than when the inſtrument was graduated; and the contrary is to be concluded, when the air-glaſs ſtands lower than the ſpirits; *viz.* that then the air is ſo much lighter, and the quick-ſilver in the ordinary barometers lower, than at the ſaid time of the graduation; and the ſpaces anſwering to an inch of mercury will be more or leſs, according to the quantity of air ſo included, and the ſmallneſs of the glaſs tube, in which the liquor riſes and falls, and may be augmented almoſt in any proportion, under that of the ſpecific gravity of the liquor in the thermometer, to that of mercury; ſo as to have a foot or more for an inch of mercury, which is another great conveniency.

It has been obſerved by ſome, that in long keeping this inſtrument, the air included, either finds means to eſcape, or depoſites ſome vapours mixed with it; or elſe, by ſome other cauſe becomes leſs elaſtic, whereby in proceſs of time it gives the height of the mercury ſomewhat greater than it ought; but

but this, ſhould it happen in ſome of them, hinders not the uſefulneſs thereof, for that at any time may very eaſily be corrected by experiments; and the riſing and falling thereof are the things chiefly remarkable in it, the juſt height being a mere curioſity: In theſe parts of the world, long experience ſhews us, that the riſing of the mercury forebodes fair weather after foul, and an eaſterly or northerly wind; and that the falling thereof, on the contrary, ſignifies ſoutherly or weſterly winds, with rain, ſtormy winds, or both; which latter is of much more conſequence to provide againſt at ſea, than at land; and in a ſtorm the mercury beginning to riſe, is a ſure ſign that it begins to abate; as has been found in high latitudes both to the north and ſouth of the equator.

Plate I. Fig. 9. A B repreſents the ſpirit-thermometer, graduated from ○ or the freezing point, thro' all the poſſible degrees of the heat or cold of the air, at leaſt in theſe climates; C D is the air-thermometer, graduated after the ſame manner, with the like degrees; E F is a plate applied to the ſide of the thermometer C D, graduated into ſpaces, anſwering to inches, and parts of an inch of mercury, in the common barometers; G an index ſtanding on the plate, at the height of the mercury, as it was when the inſtrument was graduated, as ſuppoſe here at 29 inches and a half; L M a wire, on which the plate E F ſlips up, and down, parallel to the tube of the thermometer C D; K any point, at which the ſpirits ſtand at the time of obſervation, ſuppoſe at 38 on the ſpirit-thermometer; ſlide the plate E F, till the index G ſtand at 38 on the air-thermometer, and if the liquor therein ſtand at 38 likewiſe, then is the preſſure of the air the ſame, as at the time of graduation, *viz.* 29, 5; but if it ſtand higher, as at 30, at I, then is the preſſure of the air greater, and the diviſion on the ſliding plate againſt the liquor, ſhews the preſent height of the mercury to be 29 inches 7 tenths: Mr. *Halley* had one of theſe barometers in his ſouthern voyage, which never failed giving early notice of all the bad weather they had.

A Polypus *in the* Vena Pulmonalis; *and the Structure of that* Veſſel *by Mr.* Wm. Cowper. Phil. Tranſ. N° 270. p. 797.

MR. *Cowper* took a *Polypus* out of a child about a year old; its firſt obſervable diſorders were a quick pulſe, and a difficulty of breathing; in about four days its gums were obſerved to be ſwelled, for which they were cut, and

all ſymptoms diſappeared for five or ſix hours, after which they returned: Notwithſtanding blood letting, and the application of other remedies, the difficulty of breathing increaſed, the pulſe became ſtill lower and quicker, and in four days more the child died.

The body was open'd, and the *Viſcera* of the lower belly were found well conſtituted; in the *Thorax*, the *Thymus* exceeded the natural ſize even in children; the fore-part of the lungs appeared to be well diſpoſed, but the back parts were very hard, and much inflamed; upon making an inciſion on the diſeaſed part, purulent matter followed the knife in ſuch quantities from divers cells, that it filled the wounds as faſt as they were made, and the pieces cut from it ſunk in water; but as we approached nearer to the parts unaffected, the pieces became gradually more buoyant, till at length we came to the fore-part, which floated; the cavities of the right auricle and ventricle of the heart were filled with a *Polypus*, which was continued into the ſuperior, and inferior trunks of the *Vena Cava*; upon opening the *Vena Pulmonalis* at the baſis of the heart, Mr. *Cowper* found it there entirely filled with a *Polypus*, or coagulation of blood, which was continued into all its large branches in the lungs, and were eaſily extracted, and when laid open, appeared, as repreſented, Plate I. Fig. 10.

This *Polypus* affords us a better idea of the contrivance, and ſtructure of the pulmonary vein, than any figures thereof yet publiſhed; for tho' in different ſubjects of the ſame ſpecies we meet with frequent varieties in the diſtribution of the blood-veſſels, eſpecially of the veins; yet we no where find a more conſtant regularity, and uniformity, than in the trunks, and large branches of the pulmonary vein, of which Mr. *Cowper* has given two figures, Fig. 10. and 11. drawn, after a preparation of that vein injected with wax, and freed from the lungs in an adult human body.

The left auricle of the heart in human bodies in Fig. 10. and 11. being much leſs than the right, it was neceſſary that that part thereof next the baſis of the heart ſhould be very large as A A B; leſt the ſudden ſtrong motion of the *Syſtole*, ſhould make the refluent blood to recoil in the branches of this vein D D E E, and prevent a ready ſupply in the ſucceeding *Diaſtole* of the heart; but the weight of ſo much blood lying in the trunk of this veſſel A A B effectually prevents its retroceſſion in the lateral branches within the lungs, as D D E E, and the more, becauſe the orifices of thoſe branches D D are

not

not diametrically oppoſite at A A to the mouth of the veſſel on the baſis of the heart B, its lateral branches making acute angles with the trunk, as repreſented in Fig. 12.

An Account of uncommon Convulſions; *by Dr.* John Friend. Phil. Tranſ. N° 270. p. 799. *Tranſlated from the* Latin.

AT *Blackthorn* in *Oxfordſhire*, five little girls were ſeiſed with frequent fits of barking like dogs, together with violent motions of the head; no convulſions were obſerved in their faces, only frequent diſtortions and oſcillations of the mouth; their pulſe was like that of perſons in health, but that towards the end of the fit it was ſomewhat weaker; the noiſe, as it ſeem'd to the Dr. did not reſemble, the barking of dogs ſo much, as their howling, only that the returns were more frequent, with alternate ſobbings; the youngeſt of the girls was but ſix, and the eldeſt 15 years of age; at intervals they had their reaſon and ſenſes entire; but it was not long ere one of them, renewing her yelling, would affect the reſt; at length their ſpirits being exhauſted they would fall down like epileptics upon a couch laid in the middle of the room to receive them; for ſome time they would lie quietly and decently, but upon a new irritation or orgaſm of the ſpirits, they would beat their breaſts and other parts, and diſcommode each other.

July 12. 1700. Dr. *Friend* viſited another family at *Blackthorn*, where a boy and three girls had been ſeized with convulſions ten weeks before, without any apparent preceeding cauſe; at firſt one of the girls was affected, and the firſt fit laſted for two hours; and the reſt, as the mother informed him, were ſo ſtruck with their ſiſter's diſorder, that in a few days they were alſo ſeized therewith; at his arrival they were all before the doors upwards of half an hour at play, very briſk and unconcerned, and their complexion laudable; from this diſorder was produced no other bad effect than a little weakneſs and langour, their pulſe was in every reſpect regular; at length the eldeſt girl, about fourteen years of age was ſiezed as uſual; the only ſymptom of its approach, was a ſwelling of the ſtomach, which riſing gradually, like a ball, up the throat, ſet the muſcles of the larynx and head upon their wonted convulſions; this riſing was a certain and conſtant fore-runner of the paroxyſm; and if they endeavoured to ſtop it, it broke out with the greater violence, and continued the longer: The noiſe they made, which was inceſſant, and diſagreeable, did not ſo much reſemble the barking or howling of dogs, as had been

been given out, as an uncouth kind of ſinging, conſiſting of three notes or tones, repeated twice over, and ſucceeded by deep ſighs which ended in a plain note, that was much ſtronger and ſharper than any of the reſt; no words can deſcribe this ſong; at intervals ſhe varied her note, but when her ſpirits began to fail, her motions and bawling increaſed, till being at length almoſt choaked, ſhe would expreſs a note or two, and repreſs a little the ſhaking of her head; by this means recovering ſtrength, ſhe would renew the ſame ditty, which was always accompanied with an alternate nodding of the head backwards and forwards; the muſcles of the neck were very tenſe and inflated; all the other parts of the body were free of convulſions; all the time of the paroxyſm ſhe had her ſenſes entire, and would ſit or walk, as ſhe pleaſed, but could not utter one word; her complexion did not change, her eyes were immovable as if dead; ſhe had no diſtortion but in her mouth, which by reaſon of the contraction of the muſcles was quite a *Spaſmus cynicus*; during the paroxyſm you could ſcarce feel a pulſe; and thus ſhe continued upwards of half an hour; tho' the brother and ſiſters ſtood by, yet they were not ſeiſed with the *Spaſmus* as uſual: They ſlept pretty well in the night, provided they were inclined to it, when they lay down; but if not, they were ſeiſed with the paroxyſm till morning, at the ſame intervals as in the day time; the girls of the other family were troubled with this diſorder about the beginning of the year, at which time their mouth was diſtorted and ſwelled; and a little after that theſe juſt mentioned, had convulſions, the others were ſeiſed with epileptic fits and a total deprivation of ſenſe; they would ſometimes, as if they were poſſeſſed, beat upon their breaſts, and at other times run about, *&c.* but there was nothing of this the firſt three months, only the ſymptoms the Dr. has already deſcribed.

The uncommon appearance, or long continuance of theſe ſymptoms does not hinder concluding that this is a natural diſorder; for this *Spaſmus* agrees with all other convulſions; as ariſing from the irregular motions of the animal ſpirits within the nerves, variouſly contracting the muſcles according to the diſpoſition of the orgaſm; ſo that in this caſe nature does nothing but what is uſual in other kinds of convulſions; uſing the ſame organical motions here, as in the *Chorea S. Viti*, or in hyſteric diſorders, where the patient is at one time ſeiſed with laughing, at another with howling, and at another time beats upon the breaſt; all which is occaſioned by the various and involuntary motions of the muſcles; ſeeing therefore the muſcles of the larynx, head, hands, and

and feet are equally diſpoſed to convulſions, whatever ſeems to be ſtrange and uncommon in theſe girls, is owing not ſo much to the nature of the ſymptoms, as to the part affected.

A Water-ſpout *obſerved in the* Downs; *by Mr.* Patrick Gordon. Phil. Tranſ. N° 270. p. 805.

MR. *Gordon* obſerved between the hours of 10 and 11 in the forenoon a remarkable water-ſpout in the *Downs*; it bore N. by E. off the ſhip he was in, and about two leagues diſtance by eſtimation; the wind at E. N. E. a top-ſail gale, and very cold; the horizon was entirely open and ſerene, except its northern parts from N. N. W. to N. E. by E. or thereabouts; the higheſt part of the cloud appeared to make an angle of 45 deg. of elevation; the upper half of the cloud was very white, and the other extremely black; the ſpout itſelf, which hung from the lower part of the whitiſh cloud, hovered up and down for about 20 minutes, and for two or three minutes, that part of the ſea exactly under the ſpout, ſparkled up water to a conſiderable height; the ſparkling run along to the leeward (the cone of the ſpout moving that way, and making, it ſeems a diſcharge, tho' not viſible to us) and continued running along for ſix ſhips length; afterwards the body of the ſpout did quickly contract itſelf, and then it diſappeared; about two hours afterwards the heavens were intirely overcaſt, and during that afternoon there fell abundance of hail, and both the wind and cold increaſed: Mr. *Gordon* had ſeen ſeveral water-ſpouts in the *Mediterranean*, and thoſe uſually during the time of a ſtark calm, and in hot ſummer weather; but to ſee one in our northern climate in *March*, whilſt the weather is both cold, and windy, is he preſumes, a little unuſual.

Obſervations on Inſects *in* Virginia; *by Mr.* John Banniſter, *with Remarks thereon by Mr.* Ja. Petiver. Phil. Tranſ. N° 270. p. 807.

1. *VEſpæ Ichneumones*, of which there are in *Virginia* divers kinds, all of them long, and ſlender-waſted; they make their neſts of dirt, and are therefore called dirt-waſps; ſome of them make their neſts contiguous to one another, each adjoining cavity having in it two or more partitions; others build them in clamps one upon another, they fix them againſt a wall or cieling of a houſe, or any where that is dry; there is not above two waſps belonging to each waſpary; for when they have made one cell, and put therein ſix or eight live ſpiders, they cloſe it up to work upon another, leaving them to brood upon their young, ſome-

ſomething like that *Ariſtot. Hiſt. Animal. lib.* 1. *cap.* 20; the young ones of theſe are incloſed in a thin tranſparent horny pellicle of the colour of amber; thoſe of the other are included in a brown caſe, with a certain number of regular protuberances at one end thereof; ſome again lie in brown ones, that are ſmooth, and ſome are without any caſe. *vid. Mart. Liſter Hiſt. Anim. Cap.* 5.

2. There are ſeveral other colour'd waſps; two black and white, that build their neſts on the ſmall branches of trees; of the leſſer kind of neſt there is a very good figure, and deſcription in *Piſo's Nat. Hiſt. of Braſil, lib.* 5. *cap.* 12. *p.* 287, only that as it ſeems to ſtand erect, it ſhould have been made pendulous; this is of an oval form, and about the bigneſs of a gooſe-egg; the other is much larger, and more round; the waſps alſo are ſomewhat bigger: Mr. *Banniſter* found a third ſort both in ſhape and colour like the common *Engliſh* waſp, whoſe little neſt was half round, like a clock-bell, fixt under the covert of a rotten log; the colour of theſe neſts reſembles brown paper, only the laſt inclines to the colour of ſulphur; ſome of the waſps here are brown, with purple wings; and others, have ſtreaks of yellow under their belly; theſe make their cells of the ſame matter with the former; but they are without any cover, and therefore they chuſe the ſhelter of a houſe, *&c.* tho' Mr. *Banniſter* has ſeen them ſticking in a buſh; here are alſo ſome philamot ones with purple wings, and other large ones black, and yellow, with a mouth like a brieze or ſtout, and one red, and black without wings, whoſe ſting is very long; this laſt is a very ſingular waſp, which may not improperly be called *Veſpa Virginiana impennis, ex nigro rubroque mixta.*

3. *Bombylus Teredo*; theſe bees eat into timber, and make their neſts therein; this Mr. *Banniſter* had, was in the joiſt of a houſe, ſo firm and ſound, that it was hard boring it with a piercer; the hole was but juſt big enough for the bee to creep in at, going ſtreight up about two inches in the wood, and then tranſverſely, at leaſt half a foot on each ſide, which ſeem'd to him (having probed it with a knitting-needle) to be twice as wide as the entrance; how many bees belong'd to it he could not tell, there were three within, and he heard one or two about the hole.

4. *Oeſtrum*; perhaps it is the ſame with *Aſilus Virginienſis Pennei.*

5. *Muſca carnivora vivipara*; a ſmall brown fly that diſcharges live maggots.

6. *Ci-*

6. *Cicadæ & earum Exuviæ, Mouffet, p.* 130. Mr. *Banniſter* thinks, that thoſe inſects which deſtroy'd the trees in *New England*, were *Cicadæ*; but Mr. *Petiver* had a large *Cicada* from *Maryland*, exactly agreeing with the two uppermoſt larger ones figured in *Mouffet p.* 130, on the right hand, which he cannot think were theſe that deſtroy'd the trees, becauſe they have no *Forcipes*, or other grinders to eat the leaves, but only a tube, thro' which they ſuck in dew, which is all the nouriſhment he could ever find they live upon, and moſt writers confirm the ſame; as *Mouff. c.* 17. *p.* 127. *Virgil* and *Theocritus*; and therefore he calls them dew-flies, rather than graſhoppers.

7. *Locuſtæ*, or graſhoppers; *Barrard. in Exod.* 667. 8. Mr. *Petiver* had from theſe parts a very uncommon kind, whoſe wings were entirely green, and without any ſpots or veiny reticulations, as the common large ones always have, for which reaſon he diſtinguiſhes it by the name of *Locuſta Americana major alis viridibus opacis*; one of which Dr. *Sloane* brought from *Jamaica*.

8. *Mantis*; it is neither of the tree *Mouffet* deſcribes *p.* 118, nor are the two figures in his appendix like it; that of *Piſo* reſembles it moſt, *lib.* 5. *cap.* 21. *p.* 317, but his from an inſect becomes a vegetable, which Mr. *Banniſter* cannot aver of this.

9. *Blattæ*; theſe cock-roaches are one of the plagues of this country, they are oviparous, and large; the *Peruvians* call them *Araners*, *Mouff. p.* 139; but Mr. *Petiver* rather thinks he meant the *Braſilians*, and that his *Serius* ſhould be *Lerius*, who wrote a voyage to *Braſil* in *French*, *Anno* 1594, where *p.* 159, he calls them *Arauners*; *Cluſius* alſo in his *Exotics*, *p.* 306, in his notes on *Monardes* takes notice of the ſame.

10. *Blatta volans*; theſe are very rare, Mr. *Banniſter* ſaw but one.

11. *Cimices*, or wall-lice; theſe are another of their plagues, for where there is not great care taken to deſtroy them, they are as numerous in their beds, as the former are in their kitchens.

12. *Cicindela mas*, the fire-fly; *Cicindela Mariana vaginis teneris fuſcis, marginibus fulvis.* This is not that large *Virginian* kind, whoſe head ſhines, nor is it that ſmaller ſort, which according to *Piſo*, the *Braſilians* call *Memoa*, nor the common ſort, tho' much of that ſhape and ſize; this emits its light at two creſcents, but the whole tail of the other ſhines, which it contracts or dilates at pleaſure; its ſheath-wings are of a dark purple colour, edged with yellow, as alſo its head or helmet; Mr. *Petiver* obſerves, that this is the ſame with ſeveral he had

from *Maryland* and *Carolina*; yet he found a variety amongſt thoſe from *Carolina*, ſome of whoſe ſheaths were entirely blackiſh, but their helmet edged with yellow, and which he diſtinguiſhes by the name of

13. *Cicindela Caroliniana, vaginis omnino nigricantibus.*

14. *Cicindela fœmina*, or glow-worm; its back and head are armed in a joint-armour of a deep murray-colour, faſtned to the *Thorax*; the tail conſiſted of nine ſhelly rings, in the laſt of which were viſible the two ſhining points; its head was black, and ſo ſmall that its texture could not be perfectly diſcerned without a glaſs; its eyes (if it has any) reſembled thoſe of a ſnail, ſtanding on the extremity of both horns; it had ſix legs.

15. *Scarabæus mas ſeu minor cornibus latis*, Moff. 149.

16. *Scarabæus niger ore cornuto ſeu forcipato, capite & ſcapulis colore ſuccineo elyſtris luteis eleganter notatis.*

17. *Scarabæus ore cornuto elyſtris purpureis, ſcapulis nigris ſcuti more cavis*; Mr. *Petiver* obſerves, that this beetle is found amongſt rotten wood, and logs, and when taken, it makes a ſqueaking noiſe.

18. *Scarabæus Naſicornis ore cornuto.*

19. *Scarabæus Melolanthes Naſicornis.*

20. *Scarabæus magnus noſtras, ex nigro eleganter albo depictus*; Mr. *Petiver* obſerves that this beetle is found on a rotten log, 60 miles above the habitable parts of *James*'s river.

21. *Scarabæus cornibus obtuſis.*

22. *Scarabæus cornibus acutis*; this is the holy beetle in *Tab. Hieroglyphica* mentioned by Mr. *Gregory* in his preface; there are great numbers of them here in the ſummer-time; Mr. *Banniſter* has often look'd into their rolling pellets, yet he could not find any alteration in the maſs of matter by its motion; till at length he met with one of theſe deſerted balls, in the centre of which lay a ſmall white grub, that poſſibly might owe its life to the motion; and afterwards he found in one of theſe balls two very ſmall young beetles, differing in nothing from the old one, but in bigneſs.

23. *Scarabæus ſtercorarius alter, ore forcipato.*

24. *Scarabæus ſtercorarius capite, ſcapulis, & elyſtris, quaſi ſculptura excavatis*; whether it be the *Cantharus Carolinianus obſcurè cuproſus, vaginis inæqualibus*, Mr. *Banniſter* cannot tell.

25. *Scarabæus ſtercorarius*, that flies only in the night-time.

26. *Scarabæus melolanthes*; this and that other dung-beetle amongſt the *Naſicornis* may, Mr. *Banniſter* thinks, be very aptly rank'd with thoſe of this kind.

27. *Sca-*

27. *Scarabæus luteo-viridis*; they are found amongſt *James's* town weed, *i. e. Strammonium.*

28. *Scarabæus minor viridi-cæruleus*; theſe lie amongſt the flowers of the *Apocynum.*

29. *Scarabæus colore viridi, auro radiante, & luteis maculis eleganter notatus*; Mr. *Banniſter* does not know whether the three laſt mentioned beetles may not be *Cantharides.*

30. There is alſo a ſmaller kind, all black.

31. *Scarabæus colore griſeo, ſcapulis binis quaſi oculis nigris mollitie pubeſcentibus notatus*; it is found amongſt rotten wood, and is called a ſnapper, from the noiſe it makes, by thruſting part of its neck into its breaſt, and ſpringing back again; it ſomewhat reſembles the *Cicindela Virginienſis* of *Mouffet*, but its head does not ſhine.

32. *Scarabæus arboreus piloſus.*

33. *Scarabæus arboreus minor glaber*; theſe two kinds, they ſay, the *Indians* eat.

Mr. *Petiver* had alſo the following beetles, *viz.*

34. *Bupreſtis Mariana viridis, vaginis ſulcatis, & punctatis.*

35. *Cantharus Carolinianus niger, undis palleſcentibus.*

36. *Cantharus Marianus viridis perelegans, vaginis ſulcatis, ſignaturis flaveſcentibus ornatus.*

37. *Cantharus Marianus minor, vaginis ex nigro, flavoque ſtrictis.*

38. *Capricornulus Carolinianus vaginis ex nigro, luteoque mixtis*; this has its ſhoulders black, and only edged with yellow, and its ſheath-wings equally mixt, whereas that from *Maryland* has moſt black in its ſheaths, and a yellow ring round the middle of the *Scapula.*

39. *Crio-ceros marianus caſtanei coloris antennis tortilibus membranaceis*; this reſembles the ſecond figure in *Mouffet p.* 153.

40. *Crio-ceros marianus caſtanei coloris, antennis tenuioribus geniculatis*; this is ſlenderer than the laſt, both in the body, but eſpecially in the horns, otherwiſe very like it; Mr. *Banniſter* believes they are male and female.

41. *Curculio Carolinianus ruber, maculis nigris.*

42. *Melolanthes Marianus maximus maculatus.*

43. *Melolanthes Marianus viridis, marginibus flavis.*

44. *Naſicornis Tauroceros Marianus ſplendens caſtanei coloris.*

45. *Scarabæus Carolinianus, oblongus, niger, forcipatus vaginis ſtriatis.*

46. *Scarabæus Carolinianus, ſubrotundus, niger, lævis.*

47. *Scarabæus Marianus*, like our louſe; its *Sulci* or furrows on the *Vaginæ* are larger, but otherwiſe very like N° 9. in *Banniſter's Muſæum* p. 4.

48. *Scarabæolus Carolinianus nigro flavoque mixtus.*

49. *Teſtudinulus Carolinianus, flavus margine tranſparente.*

50. *Phalena magna, cinerea, cruribus ſpinulis armatis*; the horn worm-fly, ſo denominated from a horned *eruca*, or caterpillar, that feeds on green tobacco, and towards the fall creeps into the ground, and becomes an *aurelia* of a reddiſh brown colour, in which the *proboſcis* of our moth has its *involucrum*, &c.

51. *Tinea Scorpiuncularis, libros depaſcens*; *Mouffet* in two ſeveral places tells us of ſuch an inſect, which he has deſcribed in his chapter of ſcorpions p. 172. whether ours is that he means, Mr. *Banniſter* cannot tell; it has eight legs beſides its claws; it creeps very faſt, both backwards, forwards, and ſideways, and is found in old muſty books.

52. *Phalangium Imperati*, deſcrip. 681, fig. 692. *Mouffet* in his appendix has given two figures of this ſpider, in that which ſhews its fore-parts, you have the ſite and poſition of the four larger eyes, but the four ſmaller ones, lying in a ſtreight line under them, which are alſo diſcernible to the naked eye he has omitted.

53. *Phalangium alterum*, with four large eyes in the ſegment of a circle, bending upwards, and as many ſmaller ones diſpoſed in like manner below in the fore-head.

The Spawn *of* Cod-fiſh, *&c. by M.* Leewenhoeck. Phil. Tranſ. N° 270. p. 821.

ABOUT the middle of *January* M. *Leewenhoeck* obſerved for ſeveral days the ſpawn or hom of a live cod-fiſh; but he could not bring the *Animalcula* to ſuch a poſition, as to have a full and perfect view of them, not only by reaſon of their wonderful ſmallneſs, but alſo becauſe their bodies were ſo tender and ſoluble, that when he diluted the *Semen* or ſpawn with rain water, in order to ſeparate them from each other, and afterwards exhaled the watry parts, their little bodies burſt into pieces, after which M. *Leewenhoeck* could only ſee the tail; the oval ſmall parts he concluded to be the *Animalcula* turgid with water, and burſt to pieces; and the broken parts ſeemed to be four times as large as the entire body of one of them: In another place, where ſeveral of theſe *Animalcula* lay together, they appeared like bright

bright bubbles, lying in a watry ſlimy matter, incloſed in a circular pellicle, or membrane: M. *Leewenhoeck* has obſerved more than once the aforeſaid *Animalcula* in the ſpawn of ſeveral cod-fiſh, wherein he little expected to find them living, becauſe the ſeed was not newly come from the fiſh; but ſqueezed out of the *Vaſa deferentia*, and exceeding thick; he diſcovered a vaſt number of exceeding ſmall creatures, alive and ſwimming together, having often viewed them ſo long, till the liquid matter in which they ſwam was quite exhaled, and the *Animalcula* dead; and where they were diſperſt a little, they had burſt aſunder; but where they lay thicker, and cloſer together, he could not perceive the broken pieces of their bodies: Whilſt he obſerved theſe *Animalcula*, without putting them into any liquor, they ſeemed ſmaller than when M. *Leewenhoeck* had view'd them in a round glaſs-tube: In order to repreſent their ſmallneſs, M. *Leewenhoeck* took one of the hairs of his head, and placing it near the *Animalcula*, the hair appeared thro' his glaſs to be an inch broad, ſo that at leaſt 60 of thoſe *Animalcula* could eaſily lie within its diameter; this being ſuppoſed, and their bodies being allowed to be, as they are, ſpherical, M. *Leewenhoeck* computes that 216,000 of them are equal to a globe, whoſe axis does not exceed ſuch a ſingle hairs breadth; as for the tails, he judged them to be as long, as thoſe of the *Animalcula* found in the male ſeed of a ram; one cannot eaſily perceive thoſe tails, and M. *Leewenhoeck* could not ſee the tips or ſmaller ends thereof; for as all tails are thickeſt in that part, which immediately joins the body, theſe, even there, were not ſo thick, as the tip of the tails of the above-mentioned *Animalcula:* Whereas, there is a vaſt difference in the conſiſtency of the ſkin, fleſh, and bones of a cod-fiſh, when compared with the ſame parts in a ſheep, or other land-animal; ſo likewiſe M. *Leewenhoeck* obſerved, that the ſame may be aſſerted of the ſeveral kinds of *Animalcula* found in the male ſeed of different animals; for, of the ſeveral thouſands he took out of the teſticles of a ram, he never found any that broke to pieces; tho' ſeveral of their bodies, after the exhalation of the moiſture, might be obſerved flat, *&c.* M. *Leewenhoeck* attempted ſeveral times to take off the uppermoſt ſkin of ſome of theſe *Animalcula* of a ram (which he had kept five months together upon glaſs before his microſcope) with a very fine pencil dipt in water, in hopes of making farther diſcoveries, but he could not ſucceed.

In *January*, M. *Leewenhoeck* took a live cod-fiſh, and finding that its ſeed came very thin from it, with a little preſſing, he took

took a drop thereof, wherein he diſcovered a vaſt number of *Animalcula*; he repeated his obſervation the ſame evening, with the ſame ſucceſs, but next day he could find none of them alive; and whereas, he had laid that drop upon a ſmall copper-plate, he ſuppoſed that the exhalation of the moiſture might be the occaſion of their death, and not the coldneſs of the weather, which at that time was very moderate: In the beginning of *April* M. *Leewenhoeck* took the male ſeed of a jack or pike, but could diſcover nothing more than in that of a cod-fiſh, but having added four times as much water in quantity, as the matter itſelf was, and then making his obſervations, he could perceive, that the *Animalcula* did not only become ſtronger, and ſwifter, but he ſaw them move with the ſame celerity, a river fiſh does, when chaſed by an enemy juſt ready to devour it; it is obſervable, that this whole courſe was no longer than the diameter of a ſingle hair of a man's head.

A Scale *of the Degrees of* Heat. Phil. Tranſ. N° 270. p. 824. *Tranſlated from the* Latin.

0		THE heat of the air in winter, when the water begins to freeze; and it is diſcovered by exactly placing the thermometer in compreſſed ſnow, at the time it begins to thaw.
0, 1, 2.		The heat of the air in winter.
2, 3, 4.		In the ſpring and fall.
4, 5, 6.		In ſummer.
6		The heat of the air at noon about the month of *July*.
12	1	The greateſt degree of heat the thermometer received on the contact of a man's body, as alſo that of a bird hatching her eggs.
14 $\frac{3}{11}$	1 $\frac{1}{4}$	Almoſt the greateſt degree of heat of a bath, which a man can bear by moving his hand therein for ſome time; and that of blood newly drawn is nearly the ſame.
17	1 $\frac{1}{4}$	The greateſt degree of heat of a bath, which a man can bear for ſome time without ſtirring his hand therein.
20 $\frac{8}{11}$	1 $\frac{3}{4}$	The heat of a bath whereby melted wax ſwimming thereon, by cooling hardens and loſes its tranſparency
24	2	The heat of a bath, whereby wax ſwimming thereon, is melted by growing hot, and kept in continual fuſion without ebullition.

The

28 4/11	2 1/4	The mean heat between that whereby wax melts and water boils.
34	2 1/2	The heat whereby water has a ſtrong ebullition, and a mixture of two parts of lead, three of tin, and five of tin-glaſs, by cooling hardens; water begins to boil with a degree of heat of 33 parts, and by boiling ſcarcely acquires any greater degree than that of 34 1/2; but iron growing cold, with the heat of 35 or 36 parts, when hot water, and 37, when cold water is dropp'd thereon ceaſes to cauſe any ebullition.
40 4/11	2 3/4	The leaſt degree of heat, whereby a mixture of one part of lead, four parts of tin, and five parts of tin-glaſs, by growing hot is melted, and kept in continual fuſion.
48	3	The leaſt degree of heat, whereby a mixture of equal parts of tin and tin-glaſs is melted; this mixture, with the heat of 47 parts, by cooling coagulates.
57	3 1/4	The degree of heat, whereby a mixture of two parts of tin and one part of tin-glaſs is melted, as alſo a mixture of three parts of tin and two of lead; but a mixture of five parts of tin and two of tin-glaſs, with this degree of heat, by cooling hardens, and in like manner a mixture of equal parts of lead and tin-glaſs.
68	3 1/2	The leaſt degree of heat, that melts a mixture of one part of tin-glaſs and eight parts of tin; tin by itſelf is put into fuſion with the heat of 72 parts, and by cooling hardens with the heat of 70 parts.
81	3 3/4	The degree of heat that melts tin-glaſs, as alſo a mixture of four parts of lead, and one part of tin; but a mixture of five parts of lead and one part of tin, when melted, and cooling again, it hardens with this heat.
96	4	The leaſt degree of heat that melts lead; lead, by growing hot, is melted with the heat of 96 or 97 parts, and cooling, it hardens with 95 parts.
114	4 1/4	The degree of heat, whereby ignited bodies, in cooling, quite ceaſe to ſhine by night; and again, by growing hot, begin to ſhine in the dark, but with a very faint light, which is ſcarcely perceptible; in ſuch a degree of heat there melts a mixture of equal parts of tin, and *Regulus Martis*,

and

		and a mixture of ſeven parts of tin-glaſs and four parts of the ſaid *Regulus* by cooling hardens.
136	4½	The degree of heat with which ignited bodies glow by night, but not at all in the twilight; and with this degree of heat both a mixture of two parts of *Regulus Martis* and one part of tin-glaſs; as alſo, a mixture of five parts of the ſaid *Regulus*, and one part of tin by cooling hardens; the *Regulus* by itſelf hardens with the heat of 146 parts.
161	4¾	The degree of heat whereby ignited bodies manifeſtly glow in the twilight immediately preceeding the riſing of the ſun, or after his ſetting, but not at all in a clear day, or but very obſcurely.
192	5	The degree of heat of live coals in a ſmall kitchen-fire, made up of bituminous foſſils, and that burn without uſing bellows; as alſo, the heat of iron made as hot as it can be in ſuch a fire; the degree of heat of a ſmall kitchen-fire made of faggots, is ſomewhat greater, *viz.* 200 or 210 parts; and that of a large fire is ſtill greater, eſpecially if blown with bellows.

In the firſt column of this table are the degrees of heat in arithmetical proportion, beginning with that which water has when it begins to freeze, being as it were the loweſt degree of heat, or the common boundary between heat and cold; and ſuppoſing that the external heat of the human body is 12 parts; in the ſecond column are ſet down the degrees of heat in geometrical proportion, ſo that the ſecond degree is double the firſt, the third double the ſecond, and the fourth double the third; and let the firſt degree be the external heat of the human body in its natural ſtate: It appears by this table, that the heat of boiling water is almoſt thrice greater than that of the human body, of melted tin ſix times, of melted lead eight times, of melted *Regulus* twelve times, and the heat of an ordinary kitchen fire is ſixteen or ſeventimes greater than that of the human body.

This table was conſtructed by the help of the thermometer, and red hot iron; by the thermometer were found all the degrees of heat down to that whereby tin is melted, and by the hot iron were diſcovered all the other degrees; for the heat which hot iron, in a determinate time, communicates to cold bodies near it, that is, the heat which the iron loſes in a certain time, is as the whole heat of the iron; and therefore, if equal times of cooling be taken

the

the degrees of heat will be in geometrical proportion, and therefore eaſily found by the table of logarithms; firſt it was found by the thermometer with linſeed oil, that if, when it was placed in melted ſnow, the oil poſſeſſed the ſpace of 1000 parts; the ſame oil rarified with the heat of the firſt degree, or that of a human body poſſeſſed the ſpace of 10256 parts; with the heat of water, juſt beginning to boil, the ſpace of 10705; with that of water ſtrongly boiling, the ſpace of 10725 parts; with that of melted tin beginning to cool, and to be of the conſiſtence of an *Amalgama*, the ſpace of 11516; and when it is quite hardened the ſpace of 11496; therefore, the rarified oil was to the ſame expanded by the heat of the human body, as 40 is to 39; by that of boiling water, as 15 to 14; by that of tin beginning to cool, coagulate, and harden, as 15 to 13; and by the heat of cooling tin when quite hardened, as 23 is to 20; the rarefaction of air by an equal heat was ten times greater than that of oil, and the rarefaction of oil was fifteen times greater than that of ſpirits of wine; from theſe *Data* putting the degrees of the heat of the oil proportional to its rarefaction, and taking 12 parts for the heat of the human body, you then have the degree of the heat of water when it begins to boil, *viz.* 33 parts, and when it boils more vehemently 34; of tin when melted, or when it begins in cooling to harden, and have the conſiſtence of an *Amalgama*, 72 parts, and in cooling is quite hard, 70 parts.

Having diſcovered theſe things, in order to inveſtigate the reſt, there was heated a pretty thick piece of iron red hot, which was taken out of the fire with a pair of pinchers, which were alſo red hot, and laid in a cold place, where the wind blew continually upon it, and putting thereon particles of divers metals and other fuſible bodies, the time of its cooling was marked, till all the particles were hardened, and the heat of the iron was equal to the heat of the human body; then ſuppoſing that the exceſs of the degrees of the heat of the iron, and the particles above the heat of the atmoſphere found by the thermometer, were in geometrical progreſſion, when the times are in an arithmetical progreſſion, then the ſeveral degrees of heat were diſcovered; the iron was laid not in a calm air, but in a wind that blew uniformly upon it, that the air heated by the iron might be always carried off by the wind, and the cold air ſucceed it alternately; for thus equal parts of air were heated in equal times, and received a degree of heat proportional to the heat of the iron; the ſeveral degrees of heat thus found had the ſame ratio amongſt themſelves with thoſe found by the thermometer; and therefore, the rarefac-

tions of the oil were properly aſſumed proportional to its degrees of heat.

The Death-watch; *by Mr.* Wm. Derham. Phil. Tranſ. N° 271. p. 832.

OF theſe death-watches, or inſects, which make a noiſe like the beats of a watch, Mr. *Derham* obſerved two ſorts; of which there is a very exact and true account Phil. Tranſ. N° 245. the inſect there deſcribed being leſs ſhy, and much bigger than that he diſcovered ſome years ago; Mr. *Derham* had caught ſeveral of them, two of which, a male and a female, he kept alive in a little box about three weeks, and could make one of them beat, when he pleaſed, by imitating its beating; at laſt one died, and the other gnawed its way out thro' the ſide of the box: The reaſon why Mr. *Derham* judges, that theſe are male and female, is, becauſe he has often by his ticking noiſe invited the male to get upon the other in the way of coition; that which he took to be the male was ſomewhat ſmaller than the other, and freeſt in anſwering his beats; before he got upon the other, he would beat very eagerly; and when he found that he was got up in vain, he would get off, and beat again eagerly, and then up again; from whence Mr. *Derham* conjectures, that theſe pulſations is the way theſe inſects wooe each other, and invite to copulation; this Mr. *Allen* takes no notice of in his account; from which Mr. *Derham* differs, only concerning the part, with which the ticking noiſe is made, which Mr. *Allen* ſays is the extreme edge of the face; which may be called the upper lip; but Mr. *Derham* obſerved, that the inſect always drew back its mouth, and beat with its forehead.

The other death-watch is an inſect, in appearance quite different from the laſt; it beats only about ſeven or eight ſtrokes at a time, and quicker; but this will beat ſome hours together, without intermiſſion, and its ſtrokes are ſlower, and like the beats of a watch; Mr. *Derham* had for ſeveral years obſerved theſe two ſorts of beatings, but he took it to be made by one and the ſame animal: The inſect which makes this long beating, is a ſmall, greyiſh animal, much reſembling a louſe, when looked on with the naked eye; for which reaſon, he calls it *pediculus pulſatorius*; it is very nimble in running to ſeek ſhelter when diſturbed; it is very common in all parts of the houſe, in the ſummer-months; they are extremely ſhy of beating, when diſturbed, but will beat freely enough before you, and alſo anſwer you, when you beat, if you can view them without giving any diſtur-

diſturbance, or ſhaking the place where they lie, &c. Mr. *Derham* cannot tell whether they beat in any other thing, but he has heard their noiſe only in, or near paper: Concerning their noiſe, he has ſome doubt, whether it be made by beating their heads, or rather their ſnouts againſt the paper; or whether it be not made after ſome ſuch manner as graſs-hoppers and crickets; Mr. *Derham* rather inclines to the former opinion; but his reaſon for doubting, is, becauſe he had obſerved the animals body ſhake, or give a ſudden jirk at every ſtroke, but could ſcarcely perceive any part of its body touch the paper; it is poſſible it might beat the paper, and he not perceive it, by reaſon its body is ſmall, and near the paper when it beats, and its motion in beating is ſudden, and ſwift; for which reaſon alſo, it is hard to perceive the inſect beat, without a very quick eye; and therefore he made uſe of a convex-glaſs, which by magnifying gave him a much better opportunity of obſerving it: This ticking noiſe, Mr. *Derham* judges to be a wooing act, by reaſon he obſerved another, after much beating, come and make offers to the beating inſect, who left off his beating, and got upon the back of the other; after they had conjoined, he got off again, and they continued ſome hours joined tail to tail, like dog and bitch in coition; the female he ſaw was ſomewhat bigger than the male, and of a lighter colour, inclining to a yellow, but whether all are ſo, Mr. *Derham* could not ſay; formerly, he had often purſued this noiſe but he thought himſelf diſappointed, when he found nothing but ſome of theſe *Pediculi*, which he did not perceive to beat, and which he little imagined could have made ſo ſonorous a noiſe, as he had heard ſome of them make, even as loud almoſt, as the ſtrongeſt beats of a pocket-watch; but finding a piece of paper, in which he was ſure the beating was, and happening to be looſely folded up, ſo as to be viewed throughout, and alſo lying in a good light, Mr. *Derham* viewed it narrowly, but he could only ſee ſome of thoſe *Pediculi*, and obſerving them with a convex-glaſs, he ſoon perceived ſome of them beat, or make a noiſe, with a ſudden ſhake of their body, as has been deſcribed; and he was ſo uſed to it, as to be able to ſee and ſhew their beating, almoſt when he pleaſed, by having a paper with ſome of them conveniently placed therein, and by imitating their pulſation, which they will readily anſwer; whether this inſect changes its ſhape, and becomes any other animal, Mr. *Derham* could not tell, but he has ſome (tho' very little) reaſon to ſuſpect that it becomes a ſort of fly.

The Human Allantois *diſcover'd*; *by Dr.* Rob. Hale. Phil. Tranſ. N° 271. p. 835.

MOST of the ancients allow a human *Allantois*, not from their experience, but becauſe they took it for granted, that man, and other animals were alike in the *Viſcera*, membranes, veſſels, *&c.* and the accounts they have left of many parts, particularly of the *Urachus* and *Allantois*, as to their name, figure, ſite, *&c.* agree only to their appearance in brutes: Dr. *Needham* firſt diſcover'd part of the *Allantois* in human ſubjects; but neither he, nor any other anatomiſt, have taken the right method of finding it entire; he ſays, that after the *Amnios* is cleared, and left fixed to the umbilical rope, you may divide by the fingers, or a knife, the remaining part of the *Involucra* into two membranes; the exterior he juſtly calls the *Chorion*, the interior he takes to be the *Allantois*; but by theſe ways of ſeparation, you will preſently tear the *Allantois*, and be able to diſcern only ſome ſmall pieces of it; beſides, the *Allantois* is at firſt ſight ſo like the *Amnios*, that ſeveral who ſuppoſe the *Amnios* double, and that its coats are eaſily ſeparable, have taken theſe pieces of the *Allantois*, for broken parts of one of the coats of the *Amnios*; whereas, having firſt found the *Foramen*, whence the urine is diſcharged, (if the *Allantois* is not too much torn) you may blow up the *Allantois* with a blow-pipe to its full dimenſions, and then ſee its true ſhape, the *Fundus*, the *Cervix*, the inſertion there of the *Urachus*, and its relation there to the other membranes, *&c.* let the *Allantois* be never ſo much torn, yet this way you may eaſily ſeparate ſeveral inches of it from the *Chorion* and *Amnios*; which eaſy ſeparation demonſtrates a diſtinction of membranes, ſince no double membrane can be divided by the breath alone: Indeed *Hoboken* and *Diemerbroeck* make it a very eaſy thing to ſeparate the *Allantois* from the other membranes, only by the fingers; but it is plain from their deſcriptions, that they never ſaw one entire; amongſt other miſtakes, *Diemerbroeck* ſays, that the urine of a *Fœtus* lies between the urinary membrane, and the *Chorion*, and tho' not contained in a diſtinct bladder, yet it was found in a cavity made partly from the *Chorion*, and partly from the urinary membrane: It is true, *De Graef* tells us, that by blowing with a blow-pipe into a hole made thro' the *Chorion*, all the membranes of the *Secundines* will appear diſtinct; he has alſo delineated an *Allantois*, with the other

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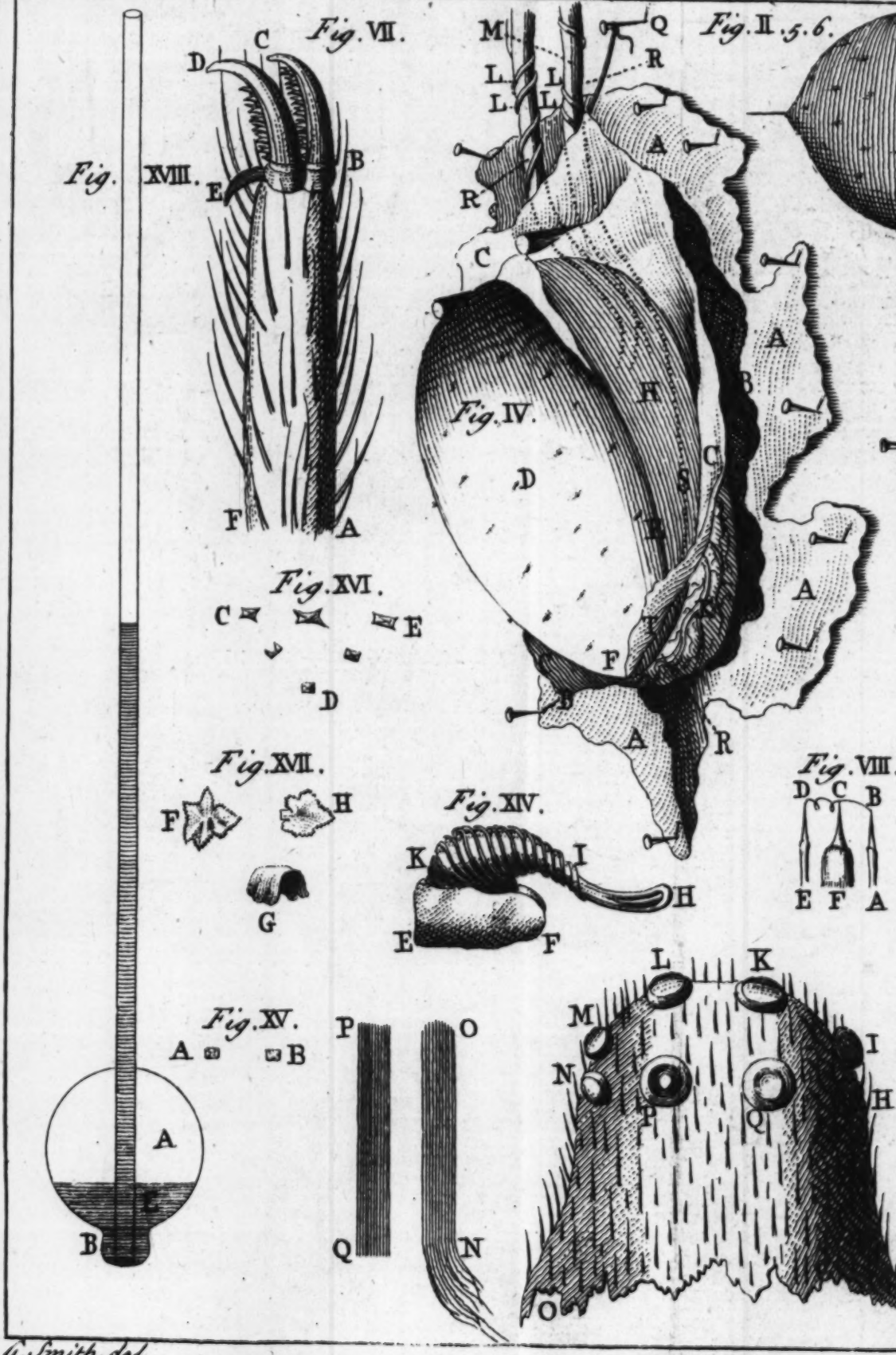
membranes, &c. as he ſays he found them; yet this figure muſt have been drawn from his own fancy, and not from any preparation; and that for theſe reaſons, 1. Becauſe by this way of ſeparation, you can only part the *Allantois* from the *Chorion*, but never ſee its true dimenſions, nor any appearance of a bladder; for a bladder, as the *Allantois* is, can be ſhew'd only by blowing into its cavity, or by finding it full; yet in this figure no ſign can be obſerv'd where it was blown up, and tied; nor can this *Allantois* be ſuppoſed full of urine, becauſe it is not of the ſhape of a full *Allantois*; and he himſelf calls it, only the inflated part of the *Allantois*; however Dr. *Hale* cannot conceive how the *Allantois* could remain partly filled with air, (any more than it might with urine) unleſs ſome hole was tied up, whence the urine was diſcharged, and the air blown in. 2. Becauſe in this figure the umbilical rope ſeems to run thro' both *Amnios*, and the *Allantois*, to its inſertion on the *Placenta*; whereas, the *Allantois* is no where perforated by the umbilical rope, nor does it any where paſs thro' the *Amnios*, but only runs under it, at the place of its inſertion on the *Placenta*; if the navel-ſtring could be allowed to enter the *Amnios*, and paſs under it to the *Placenta*, why ſhould it not appear (which it does not) under the *Amnios*, as well as the thin ſubſtance of the *Allantois?* Again, as to *De Graef*'s poſition of the *Secundines*, nothing could hinder a plain view of the place, where the navel-ſtring is ſet on to the *Placenta*; this will eaſily be apprehended, by ſuppoſing the part H in Plate II. Fig. 1. to lie uppermoſt, the *Fundus* G, and navel-ſtrings being turn'd over; for then the ſtrings will run over the *Allantois*, as in *De Graef*'s gut, and its inſertion will appear plain on the *Placenta*, which yet cannot be diſcovered in his figure, which is altogether irregular, and Dr. *Hale* takes it to be fictitious; as for the urinary membrane G in *De Graef*'s figure, it ſeems to be the *Allantois* of a colt, (where *Needham* ſays, the umbilical rope runs thro' the urinary membrane) not leſs abſurdly added to the *Secundines* of a human *Fœtus*, than the *Secundines* of a whelp are aſcribed to a like *Fœtus* by *Veſalius*.

Needham's deſcription of this membrane is falſe in ſeveral particulars; for, 1. The urinary membrane does not cover the whole *Fœtus*, as he affirms, but only that part of it which reſpects the *Chorion*, and does not lie on the *Placenta*; for the *Allantois* can be extended at fartheſt but to the edges of the *Placenta*, where the *Amnios* and *Chorion* are ſo cloſely joined by

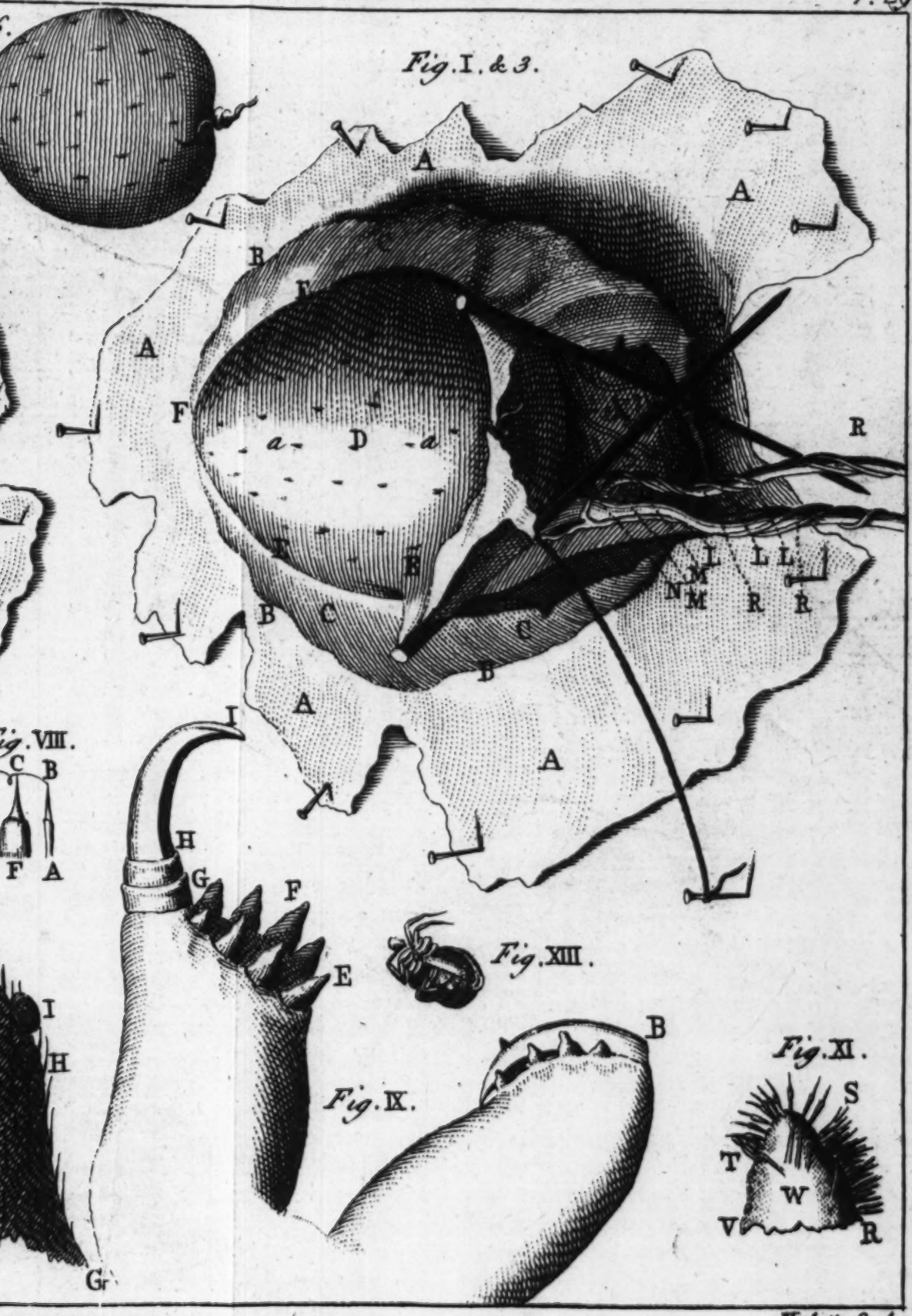
by fibres, that no membrane can come between them; wherefore, 2. The *Allantois* is not every where faſten'd to the *Chorion*; and conſequently, 3. The *Allantois* cannot be of the ſame ſhape with the other membranes, nor reſemble the *Allantois* of a colt, which contains the *Fœtus* in the *Amnios*, all which, *Needham* aſſerts; in ſhort, he ſaw only ſome pieces of the urinary membrane, but never an entire one, and ſo he could only gueſs at the ſhape, *&c.* thereof, from what he had obſerved in mares, and glanduliferous animals; he might have made a better gueſs at the figure, ſite, *&c.* of a human *Allantois*, from that of a whelp, which does not every where incompaſs the *Fœtus*, as he obſerves.

Bidloo, in moſt of the figures of the *Secundines*, marks ſome veſtiges of the urinary membrane; but in any of theſe figures, are only to be ſeen broken pieces of one, placed ſo confuſedly, that no idea of its bigneſs, ſhape, or ſituation can be form'd therefrom; Dr. *Hale* owns, that the membranes of the *Secundines* are oftentimes ſo torn, that no art can exhibit an entire *Allantois*; however, among the many *Secundines* that have come under the hands of anatomiſts, ſeveral, no doubt, muſt have been entire enough for a fuller diſcovery, than they have made, had it not been for their ways of proceeding, *viz.* by knife, fingers, or blowing under the *Chorion*, impoſſible to diſcover any thing plain or ſatisfactory, even in the faireſt ſubjects: The difficulty of finding this membrane, is by no means an argument againſt its exiſtence; but a woman that dies big with child, is ſo fair a ſubject for the diſcovery of three membranes, that Dr. *Hale* wonders *Parey*, having ſuch an opportunity, could find but two; Dr. *Tyſon* obſerved three membranes in a like ſubject; and after the *Chorion* was divided and laid aſide, he ſaw two bladders, containing liquors of different colours; which, upon preſſing one towards the other, did not mix, but remain'd diſtinct, this obſervation fully ſatisfied that anatomiſt, as to the exiſtence of an *Allantois*; and its figure, texture, ſite, *&c.* might alſo have been diſcovered by him, had not the leſs curious ſpectators been impatient to paſs on to other parts of the diſſection: Some deny an urinary membrane to a human *Fœtus*, becauſe they ſuppoſe that the *Urachus* is impervious, and that therefore there would be no paſſage for the urine, conſequently no need of an *Allantois*; *Needham* indeed ſays, that he could never find any ſign of a cavity in the *Urachus*; yet was of opinion, that by blowing from the bladder, the air might be forced thro' a human

Ura-


Fig. XVIII.
Fig. VII.
Fig. II. 5. 6.
Fig. IV.
Fig. XVI.
Fig. XVII.
Fig. XIV.
Fig. VIII.
Fig. XV.
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G. Smith del.



Hulett Sculp

Urachus, as eaſily, as he has often done it thro' that of a whelp; Dr. *Hale* cannot underſtand, why Dr. *Needham*, and others, ſhould inſiſt ſo much upon an apparent cavity in the *Urachus*, or expect that air ſhould neceſſarily paſs thro' it upon blowing, or think that otherwiſe it cannot be fit for the aſſigned office; ſince ſeveral bodies, as membranes, *&c.* will not admit air, *&c.* yet let water paſs freely through them; it will not ſeem ſtrange, that water ſhould paſs through the ſubſtance of the *Urachus*, if we conſider that the cavity of the *Urachus* to the navel is open, as appears by inflation, or injections (not to mention any thing of thoſe who are ſaid to have made water by the navel) and that the reſt of the *Urachus* is pervious, tho' not plainly hollow (the urine rather ſoaking gently, than running through its more ſtreight tubes) may be gather'd from hence. 1. That the ſubſtance of the *Urachus*, as well as the cavity of the *Allantois*, is always found turgid with a liquor, that in colour, taſte, and ſmell, ſeems to be urinous. 2. That ſince the mucous coat of the inteſtines is demonſtrated to be vaſcular by M. *Leewenhoeck*, therefore, the mucous ſubſtance of the *Urachus* may alſo be vaſcular. 3. That urine may as eaſily ouze through theſe mucous veſſels, as other fluids run through vaſcular cartilages and bones, *&c.* or the chyle into the lacteals, whoſe orifices (as M. *Leewenhoeck* obſerves, will ſcarce admit particles ſo big, as the 1000000000 part of a grain of ſand) the great cavity of the inteſtines being open at the ſame time; or as eaſily, as groſſer parts of the *Semen* paſs the tubes of the teſticles, whoſe cavities are not more perceptible; Dr. *Hale* is very ſure that the urine is more aſſiſted in its motion by the *detruſor Urinæ*, &c. than any of theſe fluids can be by the heart, or other muſcles.

Others will not admit of an urinary membrane; imagining it would be uſeleſs; becauſe, they think, that when the bladder is full, the urine muſt be diſcharged at its *Cervix*, and not at its *Fundus*, by the *Urachus*; but in anſwer to this, the urine can never paſs through the *Cervix* and *Urethra*, unleſs the abdominal muſcles contract, becauſe we never void urine naturally, but by the help of theſe muſcles, nothing leſs being able to force open the *Sphincter veſicæ*; now it being more than probable, that theſe veſſels never act before reſpiration, no urine can paſs through the *Sphincter* before the child breathes; no reaſon can be given, why the abdominal muſcles of a *Fœtus* ſhould voluntarily contract; ſince neither the quantity, or quality of the urine can excite to ſuch an action; for

when

when the bladder is too full of urine, it will ouze through the lax ſpongy ſubſtance of the *Urachus*, being gently preſſed by the *Detruſor* alone; there would ariſe ſeveral inconveniencies from the voluntary contraction of the abdominal muſcles of a *Fœtus*, as voiding *Fæces* as well as urine, into the *Amnios*, which would be more prejudicial than ſweat, *&c.* yet if we ſhould ſuppoſe that the abdominal muſcles of a *Fœtus* act, the urine will however paſs where it can moſt eaſily, *i. e.* through the *Urachus*, which is partly open, and altogether of ſuch a texture, as in no wiſe to hinder the paſſing of the urine; much leſs be able to reſiſt a conſiderable force, as the *Sphincter veſicæ* can; beſides, the *Urachus* is not only thus qualified for the admiſſion of urine, but when the mother lies down, it is almoſt upon a level with the *Urethra*, and what has once paſs'd the *Urachus*, cannot return by reaſon of the length, ſituation, and peculiar ſtructure thereof; and the *Clauſura pudendi* happening ſometimes in both ſexes, demonſtrates, that then at leaſt, the urine cannot paſs through the *Urethra*.

Dionis not finding any *Allantois*, nor an *Urachus* plainly pervious, thinks there is no need of either, on another account; for he ſuppoſes, that the blood which ſerves for the nutrition of the *Fœtus*, is depurated from all excrement; but Dr. *Hale* cannot apprehend, what ſhould make this portion of the blood and chyle freer from excrement, than the reſt of the maſs of blood; there is indeed no portion of it, which does not contain parts unfit for aſſimulation and nutrition; and *Dionis* would have been convinced of his miſtake, had he ever open'd abortions of five months old, or upwards, their bladders being always full of urine; and ſome *Fæces* conſtantly in the intestines; it is difficult to determine, when this ſeparation of urine firſt begins; but Dr. *Hale* is apt to think it much ſooner, than is generally ſuppoſed; Plate II. Fig. 2. is the *Allantois* of a very ſmall abortion, which the Dr. has ſtill by him; ſince all the parts are perfectly formed before impregnation; not very long after impregnation they may begin to perform their offices; no doubt, they begin as ſoon as there is occaſion for any ſeparation, and a ſeparation of urine is neceſſary, when the *Fœtus* is firſt nouriſhed by the umbilical arteries.

The exiſtence of an *Allantois* is denied by ſome who grant an *Urachus*, but will have it convey the urine between the *Amnios* and *Chorion*; *Diemerbroeck*'s opinion is ſomewhat like this, only he would have the urine lodged between the urinary membrane and the *Chorion*: Theſe men do not conſider, that

the urine in this caſe would get into the *Amnios*, as well as the *Succus nutritius* of the *Chorion*; ſuch a nutritious juice of the *Chorion* is granted by the maintainers of the fore-cited opinions, as well as by thoſe, who deny an *Allantois* entirely, or ſuppoſe it to have a different figure, *&c.* from what *Diemerbroeck* aſſigns it; the tranſudation or filtration through the membranes of this juice ſeems moſt likely in mares and ſows; for in a mare, the *Chorion* is not joined to the *Uterus*, till ſhe is half gone, and in a ſow it does not adhere to the *Uterus*, till near the end of her going with young; but it is moſt evident, that the urine of a human *Fœtus* is not contain'd between the *Chorion* and *Amnios*, nor between the *Chorion* and *Allantois*, from the cloſe connection of theſe coats to one another; as alſo, from the obſervation of midwives, who often find a bladder of water, which they call a by-bladder, offering itſelf before the child, whereas the humour of the *Amnios* is little, and of the *Chorion* much leſs, and of another colour, *&c.* at the time of the birth; this by-water is taken notice of, as an argument for an *Allantois*, by Mr. *Cowper*.

Dr. *Harvey* will not allow an *Allantois* even to brutes, and fancies that the *Allantois* and the *Chorion* are the ſame membrane, having two names; the firſt from its ſhape, the other from its office, or number of veſſels; yet it is plain from *Galen*, and all the ancients, that they meant two diſtinct membranes by the *Allantois* and *Chorion:* Dr. *Harvey* thinks, that a *Fœtus* does not void urine, but that the bladder contains it, till the time of birth; what was offer'd againſt *Dionis*'s opinion, may ſerve for an anſwer to this alſo; becauſe, it was impoſſible for this anatomiſt not to obſerve ſometimes an urinary bladder, he has thought of ways to explain ſuch *Phænomena* without granting an *Allantois*; he had ſeen in ſheep, and does, as it were, a certain proceſs between the umbilical arteries, full of urine, which proceſs is no doubt the *Allantois*, though *Bartholin* calls it the *Urachus*; again, he thinks, what is called by others an *Allantois*, if it is not the *Chorion*, is ſome coat accidentally formed from a reduplication of the membranes; becauſe, ſince every membrane is double, nature may at a pinch, lodge the urine between a duplicature; yet he does not tell us how his duplicature is to be filled, ſince he allows no *Urachus*; but, in ſhort, this urinary bladder can be no duplicature of the other membranes, ſince in all animals it differs therefrom, as to figure, texture, and in having an *Urachus*, which no other membrane has; and ſince every

animal that has a bladder, muſt have a like neceſſity for a receptacle of urine till born, and ſince the *Urachus* alſo is ever alike inſerted in the ſame ſpecies of animals, and the urinary bladder conſtantly the ſame, as to ſhape, texture, ſituation, &c. the *Urachus* and *Allantois*, with its by-water, can be no accidental or preternatural things.

Plate II. Fig. 3. repreſents the *Secundines* of twins, to ſhew the *Allantois*, and its relation to the other membranes, &c. after the parts were prepared and dried; A A A A part of the *Chorion* expanded; B B B a line expreſſing the edges of the *Placenta*; C C C the *Amnios*, which is united to D the *Allantois* at E E E the line of union; F the *Cervix* of the *Allantois*; G a *Foramen* at the *Fundus* of the *Allantois*, whence the urine proceeded, and where the *Allantois* was blown up; H part of that half of the *Allantois*, which lies under the line of union, and immediately cover'd the *Fœtus*, unleſs it is ſuppoſed that the *Amnios* is continued under the *Allantois*; I I two ſtiles, or probes, thruſt under the *Amnios*, which ſupport the *Allantois*, and keep open the aperture **** of the *Amnios*, whence the twins came forth; K part of the *Placenta*, with ſome blood-veſſels injected; L L L L the arteries of the navel-ſtring filled with red wax; M M the umbilical veins, filled with green wax; N a communicant artery, by means of which all the arteries of both navel-ſtrings were filled at once, and the veins were filled by one injection in like manner; O a pin that keeps out the *Amnios*, where from the edge of the *Placenta* it runs partly to the line of union, or adheſion, and partly over the *Placenta*; P part of the *Chorion* at the edge of the *Placenta*, where it runs under the *Amnios* on the *Placenta*; Q a pin that by a thread helps to pull open the aperture of the *Amnios*; R R R the *Urachus*, lying between the arteries; *a a a a* fibres or veſſels, which faſten the *Allantois* to the *Chorion*.

Fig. 4. exhibits a ſide view of the ſame preparation, that the inſertion of the *Urachus* may be the better ſeen: Obſerve, that A, and all the ſame letters in theſe three figures, denote the ſame parts in every one; S ſhews the courſe of the *Urachus* R at F in pricked lines; T part of the *Amnios* raiſed from the edge of the *Placenta*, to diſcover the *Placenta* K and U; U that part of the *Allantois*, which is below the line of union, near its neck F.

Fig. 5. ſhews an entire *Allantois* of a very ſmall abortion, which *Allantois* was eaſily ſeparated from the other membranes, between

between which it lay, and the *Amnios* remained an entire bladder, or membrane under the *Allantois*.

It is objected, that what is called the line of union can be no real thing; as to that, Dr. *Hale* does not know, whether the *Allantois* of twins may not require ſuch a conjunction to ſuſtain, and keep ſteady a greater quantity of urine; nor can he reſolve, whether the *Allantois* of twins (like that of a ſingle *Fœtus*, Fig. 6.) may not be diſtinct, and ſeparable from the *Amnios*, which he could not diſcover; however, the reaſons why ſuch a line was figured, are theſe; 1. Although he uſed more force, with equal care, to ſeparate the *Allantois* from the *Amnios* in this place, than in any other (where nevertheleſs the ſeparation was very eaſy) yet he could not divide theſe membranes farther than that line. 2. This line ſeeming ſo regular, as to divide the *Allantois* into two equal parts, he could not take it to be the effect of chance, or of his ſeparation. 3. The part H below the line EE was alike tranſparent with that part of the *Allantois* D above it; whereas had the *Amnios* been ſtill joined to the *Allantois*, as the objection ſuppoſes, the *Allantois* below this line muſt have appeared thicker than that part above it, ſince the *Amnios* alone is much thicker, than the *Allantois*; it is eaſy indeed to conceive the *Amnios* running as an entire bladder, or membrane, under the *Allantois*, and perhaps the Dr. thought it might be ſo.

Others have taken this *Allantois* to be an *Amnios* of one of the twins belonging to theſe *Secundines*; this objection, though it may ſeem plauſible, yet is of no force; for 1. This *Allantois* is much finer to the touch, and alſo much more tranſparent than the other *Amnios*, which ſtill remains ſtiff; whilſt the much thinner *Allantois* ſinks upon the leaſt blaſt of air, notwithſtanding the ſtiles II, which ſupport it. 2. This *Allantois* had two viſible *Urachi*, and it is of an oviform figure, ſomewhat reſembling the common figure of a man's bladder; alſo this *Allantois* touches the *Placenta* no where, unleſs at the neck F; but on the contrary, the *Amnios* is of the ſame irregular figure, as the poſition, motion, *&c.* of the *Fœtus* require; likewiſe, it covers the whole internal ſurface of the *Placenta*. 3. They who make this objection muſt ſuppoſe ſome hole in this bladder, and in the *Amnios*, thro' which one umbilical rope may paſs from the *Placenta* to the *Fœtus*; but ſuch a *Foramen* would be preter-natural, becauſe the navel-ſtring runs only from the *Placenta* to the *Fœtus*, under a coat taken from the *Amnios*, and lies with the *Fœtus* in the cavity

of the *Amnios*, that is no where perforated. 4. The hole at the *Fundus* G was ſcarcely wide enough to receive the end of a man's finger, whereas the twins did not want ſix weeks of their full time; ſince therefore a *Fœtus* of near eight months could not poſſibly paſs thro' this orifice, this bladder could not be an *Amnios*.

Nothing in theſe *Secundines* is preter-natural, only that ſome things were not obſerved before; hitherto, anatomiſts have not allowed twins to lie in a common *Amnios*, but ſuppoſed that each *Fœtus* had a diſtinct *Amnios*; the reaſon of this opinion might be, that ſome denying any urinary membrane, called every membrane they found, except the *Chorion*, an *Amnios*; and theſe finding two membranes in the *Secundines* of twins, ſuppoſed them to be two *Amnii*; that others granting an *Allantois*, but not diſtinctly diſcovering it, but only two membranes, alſo imagined them to be two *Amnii*; both theſe taking that for an *Amnios*, which might really be an *Allantois*; but ſince one *Chorion* and one *Placenta* (being ever of the ſame number) generally ſerve twins, nay, ſometimes three *Fœtus's*, why ſhould it ſeem ſtrange, that one *Amnios*, at leaſt ſometimes, and one *Allantois* ſhould ſerve the like number?

Tho' *Mauriceau* and *Diemerbroeck* think there is an abſolute neceſſity for every *Fœtus* to lie in a diſtinct *Amnios*, and that otherwiſe, twins in the ſame membrane would grow together, and make a monſter; and *Aquapendens* further ſays, that all *Ova gemellifica* produce ſome other ſort of monſter; yet it is moſt certain, that *Ova gemellifica* exclude two perfect chickens, tho' not both alive: Dr. *Harvey* indeed thinks it poſſible, that ſuch an *Ovum* may produce a monſtrous chick, if its *Vitelli* are contain'd in the ſame membrane, *&c.* yet he does not poſitively ſay it muſt be ſo; but Dr. *Hale* cannot ſee any more reaſon, why twins in one *Amnios* ſhould grow together, than that the hands or heels of the ſame *Fœtus* ſhould grow to its own body; for how can the humours that lubricate a ſingle *Fœtus*, and help it to move, join two together? Since the humours are the ſame, and the parts of the ſame *Fœtus*, as tender as thoſe of twins are, and lie as cloſe to one another, as twins do: It is very obſervable, that amongſt all the monſters we read of, there are very few, which ſeem to be made of two entire bodies joined together, and that moſt of theſe upon diſſection were found to have but one heart, one liver, *&c.* whence it is moſt evident, that theſe monſters, and no doubt all others, were

were originally monſters in the *Ova*, before impregnation, and not ſo for want of an *Amnios*; yet *Diemerbroeck* does not a little boaſt his having firſt, as he thinks, found the reaſon, why twins muſt lie in diſtinct *Amnii*; but ſince the matter of fact (ſometimes at leaſt, as in theſe *Secundines*, where there was only one *Amnios*, and two regular *Fœtus*'s) is not true, his argument for a neceſſity of two *Amnii* for two *Fœtus*'s, will never prove valid, even where twins, and two *Amnii* are found; indeed any part may be made to grow to another, as is ſeen in the cure of hair-lips, *&c.* but then the fibres muſt be firſt broken before there can be any union: Now Dr. *Hale* cannot conceive, what ſhould naturally break the fibres of the twins in the *Uterus*; but altho' it is evident from what has been ſaid, that twins may lie diſtinct in the ſame *Amnios*, yet there muſt be as many *Urachi*, as *Fœtus*'s; in theſe *Secundines* Dr. *Hale* ſaw two running over the *Placenta*, to the neck of the *Allantois*, the *Urachus* paſſes under the *Amnios*, as the other umbilical veſſels do, and runs from that part, where the umbilical rope is joined on to the *Placenta*, ſtreight to the *Cervix* F; S deſcribes the courſe of that *Urachus* marked R at F Fig. 4. the other *Urachus* lay about a quarter of an inch laterally beyond that marked R in the ſame figure; by two *Urachi* the Dr. means two long roundiſh bodies, of a depreſſed figure; they ſeemed as large as a common knitting needle, and were of a darker ſubſtance than the *Placenta* on which they lay; they appeared in every reſpect like that part of the navel ſtring, which is allowed by all anatomiſts to be the *Urachus*, and in like manner ſhrunk in two or three days from a mucous ſubſtance to a mere membrane: Theſe two are the only entire urinary membranes that the Dr. prepared; yet in the ſeveral *Secundines* that came to his hands, he always found three diſtinct membranes eaſily ſeparable.

From hence we can better explain ſome phænomena; as voiding urine by the navel, and the breaking of waters from women half gone with child, and tell the conſequences of ſuch accidents; as alſo, better account for thoſe waters and bladders midwives meet with, and direct them in their doubtful operations.

An extraordinary Periodical Hemorrhage *in the* Thumb; *by Dr.* Wm. Muſgrave. Phil. Tranſ. N° 272. p. 864.

MR. *H*—— ſervant to Mrs. *Jennings* of *Burton* in *Somerſetſhire*, had from his infancy to the 24th year of his age, a periodical hemorrhage in one of his thumbs; the time of the eruption was about the full of the moon, ſeldom more than a day before,

before, or after it; the orifice was on the right ſide of the nail of the left thumb; he had not known the blood to be leſs in weight at any one periodical diſcharge, than four ounces; and when he came to be 16 years of age, the quantity was then increaſed to half a pound at each eruption; the manner of the flux was alſo remarkable; for without any pain in his head, difficulty of breathing, or any ſigns of a plethora, or other ſymptoms, excepting only a ſtiffneſs on the outmoſt joint of the ſaid left thumb; the blood uſed to ſpin out on a ſudden, with a conſiderable force, in ſeveral little ſtreams, and continue ſo to do, till the greater part of the quantity was diſcharged; under this diſcharge, however copious, he was ſtrong, and vigorous to the age of 24, from his moſt early, and tender years: At the age of 24, finding this evacuation troubleſome, and being uneaſy under it, he ſeared with a hot iron the part which uſed to open, and give vent to the flux of blood; Dr. *Muſgrave* ſaw the part, it was hard, and callous, about a quarter of an inch; the ſearing had ſtopped the hemorrhage for about twenty years: This ſtoppage was in its effects very dangerous, and of ill conſequence; for within a quarter of a year after it, he fell into a ſpitting of blood, bringing up from his lungs vaſt quantities thereof; this new complaint, together with a cough attending it, reduced him very low, ſo that Dr. *Dyke* of *Somerſetſhire* took him to be very far gone in a conſumption; but by frequent bleeding, *&c.* he freed him of this *Hæmoptoe*, yet did not give him the relief which was expected; for in a little time the patient fell into a moſt violent cholic, from no other occaſion, that he could diſcover, than his late illneſs, putting on a new form, and the matter ſettling on the bowels; this cholic was in good meaſure overcome by purging medicines, but a diſpoſition to it ſtill remained, for he had ever ſince been often troubled with it, as alſo with a ſpitting of blood, on the leaſt catching cold, or motion: He had ever ſince the ſtoppage of that firſt hemorrhage been weakly, ſickly, of a ſallow, faint look, much impaired as to health, in compariſon to what he enjoyed during the time of its periodical returns; and this affords an argument, that when nature has choſen, and for ſome time exerciſed new and extraordinary methods of œconomy, ſhe ſeems to be as fond of their continuance, as at other times, and in her moſt regular ſtate, ſhe is of that, which is her moſt uſual and ordinary courſe.

There is a further uſe to be made of this, and ſuch like monthly hemorrhages in men, whether by the thumb, *per Penem*, or any other part of the body; for theſe evacuations being analo-

nalogous to the *Menſes* in women, confute the opinion of all ach, as derive that diſcharge from a *Fermentum uterinum*; for ow can we think that the *Menſes* come from ſuch a local fer- ent, when a diſcharge, in all reſpects equivalent thereto, takes lace, where no ſuch ferment is, or can be ſuppoſed.

piders, *their Way of killing their Prey, ſpinning their* Webs, *&c. by M.* Leewenhoeck. Phil. Tranſ. N° 272. p. 867.

M. *Leewenhoeck* about the latter end of *February* caught a black ſpider, and viewing it with his microſcopes, he bſerved that its body and legs were covered with a great num- er of hairs, that ſtood as thick as briſtles on a hogs back; tho' he legs were very hairy, yet were they ſo clear, that he could afily perceive the circulation of the blood in ſeveral veins, which ere not a hair's breadth diſtant from one another; and afterwards e ſaw other fine blood-veſſels, that were not the tenth part of a air's breadth diſtant from each other; with the ſtricteſt obſer- ation, he could not diſcover the courſe of the arterial blood, but e could ſee, even in the ſmalleſt of the legs, three veſſels toge- her that conveyed the blood directly to the heart: Notwithſtand- g, that this animal is eſteemed a bloodleſs inſect by the ancients, ecauſe they could diſcover no red matter in its body, when they illed, or cruſhed it to pieces; yet M. *Leewenhoeck* plainly per- eived ſome particles of blood, which according to all ap- earance were ſpherical, circulating in a liquid matter; but theſe articles of blood were extremely ſmall, in compariſon of thoſe lobules diſcovered in larger animals, for M. *Leewenhoeck* ſaw a pace of three hairs breadth in the veins, where no particles of lood circulated; and he alſo obſerved, that the blood was ex- elled with great ſwiftneſs: M. *Leewenhoeck* viewed this ſpider everal times, and at laſt in *March* he could ſee the blood in one f the arteries, but could not diſcover where the circulation egan.

M. *Leewenhoeck* often took up that ſort of ſpiders, whoſe reech is larger and thicker than that of others, to ſee whether e could diſcover any circulation of the blood, but in vain; and o ſatisfy himſelf, whether they had any globules in their blood, e cut off one of the hinder legs of ſuch a ſpider, and viewed he blood that run out, in which he found but a very few glo- ules; but upon wounding it in the fore-part of the body, and bſerving the blood that flowed from thence, he diſcovered abun- ance of globules therein; and cutting off part of the leg of another

another ſpider, he found more globules there, tho' he could not perceive any circulation of the blood in the legs: M. *Leewenhoeck* had often ſeen a ſpider hanging down from the branch of a tree by a thread of his own making, and holding faſt by one of his hinder legs, which has three particular claws, two of which are at the very extremity, and each claw is armed with ſeveral teeth like ſaws, that towards the joining with the foot grow narrower and cloſer together, and where the thread it has ſpun, may be cloſe twiſted, juſt as in a pulley, on which clock-makers put their lines to faſten the weight, which in the beginning is wide and large, but the longer it grows, the narrower it is.

Plate II. Fig. 7. A B C D E F repreſents a ſmall part of the leg of a ſpider, B C D ſhew the two extreme claws, armed with teeth like ſaws; E the third that hath no teeth, which claw M. *Leewenhoeck* ſuppoſes the ſpider uſes on ſeveral accounts; this is certain, that when the ſpider does not wind itſelf by its thread upwards, but runs along its web, then it takes hold of the ſpun thread with this third claw; the above-mentioned ſpider is provided with eight long, and two ſhort legs, which laſt ſtand out on each ſide of the head, having ſuch claws as are before-mentioned; moreover, M. *Leewenhoeck* diſcovered eight diſtinct eyes, two of which are on the top of the head, in order to ſee what paſſes above him; below theſe were two other eyes, to look ſtreight forwards; on each ſide of the head were two more cloſe to each other; the two foremoſt to ſee, as M. *Leewenhoeck* ſuppoſes, what paſſed collaterally before him, and the two hindmoſt to ſee the ſame backwards.

Fig. 8. ſhews that part ſeparated from the membrane or pellicle it lay in; P Q the eyes that look upwards; K L thoſe that look ſtreight forwards; I M thoſe that look ſideways forward; H N thoſe that look ſideways backward; now that ſpiders eyes are immoveable, having no muſcles belonging to them, it is eaſy to conceive how neceſſary eight eyes are in order to look round about, the more eaſily to each its prey: M. *Leewenhoeck* found that the ſpider has two inſtruments or caſes for its ſting in the fore-part of the head, which, when it does not uſe, it places in great order under its eyes, and between its two ſhort legs; theſe ſtings are crooked like a claw, and very much reſemble thoſe of ſcorpions, or *Indian Millepedes*; the ſtings of a ſpider have towards the extremity and on each ſide a little hole, from whence according to all appearance, when it ſtrikes its enemy, it ejects a liquid matter, we call poiſon.

Fig.

Fig. 9. ABCDEF, *&c.* ſhews the two inſtruments that contain the ſtings; BC the ſting as it is caſed or laid up; HIK the ſting extended, and ready to wound, C and I the ſmall holes which go quite thro' in each ſting, EFG the two rows of teeth, which ſerve for a caſe to the ſtings, theſe teeth are covered with hairs; CB is the ſting when at reſt; the two rows of teeth M. *Leewenhoeck* ſuppoſes are deſigned to hold the prey it has hunted, and ſtruck with its ſting, ſo faſt that it cannot be wreſted from it; when he put two or three of the largeſt ſort of ſpiders in the glaſs, he obſerved that when they met, they never parted without an engagement, in which one has been ſometimes wounded in ſuch a manner, that its body, was wet with the blood ſpilt in the battle, and that it died ſoon after; M. *Leewenhoeck* always obſerved that the leſſer fled from the greater, and when it happened that two of an equal ſize met together, neither retired, but held each other ſo faſt with their ſtings, that one would remain dead without ſtirring once, and ſo wet with the blood it had loſt, as if it had lain ſome time in water; M. *Leewenhoeck* had one ſpider that was wounded by his antagoniſt in the thickeſt part of the leg, from whence iſſued a drop of blood as big as a large grain of ſand; not being able to uſe this wounded leg to run away from his enemy, he raiſed it up an end, and preſently after the whole limb fell off from his body; and he obſerved, that when they are wounded in the breaſt, or upper part of their bodies, they always die: M. *Leewenhoeck* obſerved that the ſpider cannot faſten its thread to any place, unleſs he firſt preſſes with his breech upon it, which preſſure cauſes a vaſt number of exceeding fine threads to iſſue out of its body; from whence may be concluded, that as ſoon as thoſe threads come into the air they loſe their viſcoſity or ſtickyneſs: When M. *Leewenhoeck* opened or diſſected a ſpider in order to diſcover that viſcous ſtringy matter, which he took to be the beginning of their web, he could not find it, being ſurpriſed how ſuch a ſtrong thread could in ſo ſhort a time proceed out of ſuch a moiſt body, ſtrong enough to bear the weight of ſix ſpiders; and when he endeavoured to find out the manner, how they make their webs, one and the ſame thread ſeemed to conſiſt ſometimes but of a ſingle thread, and ſometimes of four, or five; but he could not ſee how the threads iſſued from the ſpider's body; M. *Leewenhoeck* afterwards took a ſpider, and laid it upon its back, ſo as that it could not ſtir, and he pulled out with a very fine pair of pincers a thread, which he could perceive ſticking out of one of the working inſtruments, and at the ſame time he ſaw a great many

very fine threads iſſuing out of its body, which as ſoon as they were one or two hairs breadth diſtant from the body, were joined together and ſo made thick threads; M. *Leewenhoeck* contrived to faſten theſe fine threads whilſt they were divided, and juſt as they came out of the ſpider's body, which ſucceeded three ſeveral times, and the oftner the better; yet tho' he uſed his beſt glaſſes, thoſe threads were ſo extremely fine, as almoſt to eſcape the ſight; and in ſome places he found threads that were 25 times as thick as others that lay next them.

Fig. 10. MNOPQ repreſents a part of the threads, which came out of two of their working inſtruments, and are divided from each other, juſt as they iſſued from the body: Now, as we may perceive that a ſpider's web, which to the naked eye ſeems but ſingle, does yet conſiſt of ſeveral other threads, and thereby acquires a greater ſtrength; we may from hence certainly conclude, that no flexible bodies (excepting metals, whoſe parts are ſtrongly cemented by the force of fire) can attain to any degree of ſtrength, unleſs they conſiſt of long united parts, and the more theſe parts are twiſted together, or cemented with any viſcous matter, the ſtronger they are, which is very obvious in flax, ſilken thread, ropes, *&c.* and thus alſo hair and wool, according to its fineneſs has more or leſs ſtrength, becauſe each of thoſe hairs conſiſts of longer and finer parts, which are not only united together by a viſcous matter, but are alſo armed with a ſkin or bark, which joins more cloſely the contained parts; now if we ſeriouſly reflect on the vaſt number of fine threads that at once proceed from the body of ſuch a ſpider, we muſt own that it could not be otherwiſe; for to make a thread ſo thick and ſtrong as is neceſſary in a ſpider's web, with the viſcous matter thrown out of the animals body for that purpoſe, cannot be ſo ſoon done, nor be immediately congealed in the air, as the thin and fine threads, a 100 of which put together, will not, M. *Leewenhoeck* thinks, make the 100th part of the thickneſs of one ſingle hair of his head; in a word, we may hereby diſcover the wiſdom of God in the perfection of his creatures.

M. *Leewenhoeck* diſſected the body of the largeſt ſpider he could find, and having inveſtigated each part, he at laſt diſcovered the vaſt number of inſtruments, from whence each ſingle thread proceeded, yea, the number was ſo great, that he judged them to be at leaſt 400, but they did not lie hard by one another, but were divided into eight diſtinct parts or inſtruments, ſo that if the ſpider ſet all theſe eight to work at once, there would proceed eight particular threads, which were again ſub-

divided

divided into a great number of ſmaller; but one of the great threads was thicker than the other, becauſe one part of the body would produce twice as many threads, as the other juſt by it; when M. *Leewenhoeck* viewed the diſſected body with his microſcope, and the place where the threads iſſued, he found they were ſhut up by five diſtinct parts, which are pointed at the extremity; but from the middlemoſt there proceeds no thread at all; the other four inſtruments, which ſhoot out theſe threads, are covered externally with thick hairs, ſo that all the ſmall inſtruments lie inwards, for this reaſon (as M. *Leewenhoeck* ſuppoſes) that they may not receive any damage, when the ſpider creeps into any hole, where there is no occaſion of making its web, or when it runs along the ground in queſt of its prey; now, upon ſeparating the above-mentioned four inſtruments, one ſhall find other four lying between them, which contain yet ſmaller and ſlenderer inſtruments, from each of which proceed exceeding fine threads; after thoſe four inſtruments have been diſſected in order to expoſe to view what lies internally, the ſcene is much the ſame with that of a large field, covered with a vaſt number of pointed twigs, and each delivering out a ſingle thread; theſe inſtruments are double, and may be compared to a reed that is thicker at bottom, than a-top; out of which proceeded another, the biggeſt end whereof was incaſed within the ſmaller end of the former, and out of the ſmaller end of this laſt iſſued a thread of an exceeding fineneſs; it ſometimes happened, that M. *Leewenhoeck* could not diſcover the working inſtruments in ſome of the above-mentioned parts, which he ſuppoſed, when the ſpider did not employ them in making its web, were ſhut up, and he could ſee nothing in the place where they were wont to proceed from, but their ſmall points or tips, but with a little ſqueezing, they preſently appeared in great numbers; he alſo obſerved, that ſome of thoſe parts, from whence the threads proceeded were larger, and longer than the reſt, which he ſuppoſed did produce threads of an extraordinary bigneſs, in compariſon of the reſt: Now, if we take it for granted, as is really true, that a young ſpider juſt came out of the egg is 300 times ſmaller than a full grown ſpider, and at the ſame time allow that this young ſpider has all the working inſtruments within its body, as the old one, (which, as it grows in bigneſs, are alſo enlarged in proportion) we muſt neceſſarily conclude that the threads ſpun by the young ſpider, are 300 times ſmaller than thoſe ſpun by the old one, which fineneſs is ſcarcely conceivable.

M. *Leewenhoeck* always obſerved, that when the ſpider does not faſten its thread at one ſtretch, it is drawn inwards with bents and krinkles, upon which he concluded, that each of thoſe fine threads was round of itſelf, but by the addition of ſeveral other threads it acquired a flatneſs, as ſeveral common threads laid together appear to us; the ſame thing is alſo obſerved by gold wire-drawers, whoſe threads, if they break, or hang looſe, krinkle, and then always appear round.

Fig. 11. R S T U ſhews one of the four outermoſt inſtruments, with all its quills or reeds, which put together is not ſo large as a grain of common ſand; from whence we may imagine how ſmall thoſe inſtruments muſt be, and how fine the threads are, incaſed within them; in the ſaid figure at W the working inſtruments ſtood as thick by each other, as they do between R and S; moreover, that part from the ſight was not covered with thoſe ſorts of quills, but with hairs only; the number of quills, upon twining this inſtrument about, was upwards of a 100; M. *Leewenhoeck* obſerved before, that a few of theſe inſtruments were larger than the reſt, and conſequently produced a larger thread; Fig. 12. A B and D E repreſent two ſmall inſtruments that ſtood between two others, one of which had a krinkled or harled thread; it ſometimes happened when M. *Leewenhoeck* ſqueeſed ſuch an inſtrument as Fig. 12. inſtead of threads, there iſſued out matter that became a round drop, which he ſuppoſed was occaſioned for want of a continuation of the ſame matter; whereas the other parts that ſtood next produced threads; when M. *Leewenhoeck* preſſed the hinder part of the ſpider's body pretty hard with his tongs or pincers, it frequently happened that a round particle, the third part of an inch in length, and as thick as a horſe hair, iſſued out, very tranſparent, and of a tough and viſcous nature; which ſuggeſted to M. *Leewenhoeck*, whether this might not be the ſubſtance whereof the threads were formed, and alſo whether the body of the ſpider was not framed in ſuch a manner, as to be able to preſs, or inſinuate into its working inſtruments that mater, which was the foundation of the threads iſſuing from thence; he often cut off a piece of that part of the ſpider's body from whence theſe threads proceed, and he afterwards drew out long threads.

M. *Leewenhoeck*, at one time, took a very ſmall frog, the length of whoſe body was about an inch and a half, which he put into a glaſs tube, together with a large ſpider, in order to ſee how they would behave; when he obſerved that the ſpider paſt by the frog without touching him, yet it exerted its ſtings,

as

s if it intended to have fallen directly upon the frog; after-
vards M. *Leewenhoeck* cauſed the frog to run againſt the ſpider,
who thereupon ſtruck it in the back with its ſtings, and wound-
d the frog in ſuch a manner in two ſeveral places, that in one it
eft a red ſpeck, and in the other a blue one; hereupon
M. *Leewenhoeck* brought them together again, when the ſpider
truck its ſtings into the frog's fore-leg, who, upon that ſtruggled
o hard, that the ſpider was forced to leave it, and he obſerved
hat ſome few of the blood-veſſels in the frog's legs were wound-
d; once more M. *Leewenhoeck* forced the frog to juſtle againſt
he ſpider, who upon that ſtruck both its ſtings into the frog's
oſe, after which they both ſtood ſtill about half a minute, then
pening the glaſs he took the ſpider out, whilſt the frog lay ſtill
bout an hour, and then ſtretched out its hinder legs, and died.

The next day M. *Leewenhoeck* took another frog about the
ame ſize with the former, and another ſpider, and putting both
nto the ſame glaſs, the ſpider paſſed by the frog without med-
ling with it, but when M. *Leewenhoeck* ſhook them ſuddenly
ogether, the ſpider ſtruck both its ſtings into the frog's back,
ut he could not perceive that it was wounded ſo far as the
eins, for there was no blood ſpilt; this frog was very ſhy of the
pider, and as ſoon as the ſpider came near it, or touched it with
s feet or claws, the frog uſed its utmoſt efforts to avoid it;
gain, M. *Leewenhoeck* brought the frog ſo near, as to touch the
pider with the fore-part of its body, who thereupon gave it two
lows with its ſtings in the lower part of the head, one of which
ierced the blood-veſſels, ſo that there remained a red ſpot; the
pider quitted the frog preſently, becauſe of the ſtrong efforts
he other made to get rid of it, and then the ſpider ſet itſelf to
leanſe its ſtings with a liquor that came from its mouth for that
urpoſe; after that, M. *Leewenhoeck* ſeparated the ſpider from
he frog, and viewing the circulation of the blood in the latter
o ſee whether there was any alteration therein, occaſioned by the
ound received from the ſpider, but he could diſcover none, nor
ould he perceive that the frog had got any harm, for next day
t was brisk, as if nothing had ailed it: Now, it is poſſible that
he ſtinging of ſpiders in hotter countries may be more pernicious
han in our climate; and it is alſo poſſible, that this ſpider might
ave lately ſpent its poiſon, by wounding another ſpider, or ſome
ther animal; when M. *Leewenhoeck* had kept this frog four
ays in the glaſs tube, and found that he was never the worſe
or the ſtinging of the ſpider, he flung it into the water, and

obſer-

obſerved that it endeavoured to ſwim towards land, as all frogs do in deep waters, for fear of being devoured by the fiſh.

M. *Leewenhoeck* obſerved the blood of a ſpider, and found that every particle of blood conſiſted of ſeveral other ſmaller ones, each of which he ſuppoſed was compoſed of ſix others, analogous to the blood of the human body, and moreover he obſerved ſeveral other, yet ſmaller particles, ſome of which were leſs than others; but theſe laſt particles were not viſible, till the fine *Serum* of the blood was quite exhaled; moreover, in viewing the blood that iſſued from the feet that were cut off, M. *Leewenhoeck* obſerved, if he look'd any time upon it, the *Serum* would exhale, and the ſalt particles would cleave together, like ſo many fine twigs or branches, reſembling the night-dew when congealed on glaſs-windows; but when he forbore looking, and laid the glaſs by, the air being cool, the cryſtalliz'd ſalts returned to their former figure; and again, if he brought his warm hand but for half a minute near the glaſs, all the ſalt particles were coagulated again; but by breathing a little upon them, they were quickly reduced to a clear water; it was curious to ſee theſe ſalts, which ſeem'd to have their riſe from a point, or exceeding ſmall particle of blood, ſtream and branch themſelves, as it were, into trees: Afterwards, M. *Leewenhoeck* took up another ſpider, and put it into a glaſs-tube, in order to diſcover the circulation of the blood, which he ſaw very plain, both in the veins and arteries; and its legs being very tranſparent, like thoſe ſpiders found on trees or ſhrubs, he ſaw ſeveral times a ſudden and briſker motion of the blood, which he ſuppoſed might be occaſioned by every ſyſtole and diaſtole of the heart: M. *Leewenhoeck* took another ſpider he found on a thiſtle, which was eight times ſmaller than the large garden one, and eaſily perceived the circulation of the blood both in the veins and arteries: In the middle, or about the latter end of *October*, M. *Leewenhoeck* took ſeveral of the largeſt ſpiders he could find, and ſhut them up ſeverally in glaſs-tubes, in order to lay their eggs, and to ſee what he could diſcover in the ſaid eggs; he found in their excrements the entire wings, heads, and legs of ſmall flies, which were ſo large, that he could not conceive how they paſs'd thro' their bodies; on the 30th of *October*, he obſerved that two of the ſpiders had laid eggs, and had in a few hours covered them with a vaſt quantity of their web; which he took, and the eggs incloſed therein, and opening ſeveral of them, he found they were of a yellowiſh colour; theſe eggs were almoſt round,

round, and the axis of one of them was about the 30th part of an inch, and when they lay altogether, they made a roundiſh body, whoſe axis was half an inch; but if you look'd ſideways upon them, their diameter appeared to be the fourth part of an inch; from whence it is very eaſy to calculate what a vaſt number of eggs one ſpider will lay: Upon a narrow view of this large heap of eggs that lay in order by each other, one would be apt to judge it impoſſible for ſuch a number to proceed from the body of one ſpider; but the wonder will ceaſe, when we conſider, that the eggs are not exactly round, while they lie in the ſpider's body, but being preſſed together, they aſſume particular figures; theſe eggs being round, lying in order, and touching each other but in one point, muſt needs take up more room, than when they lay in the ſpider's belly; the membrane, or ſhell, of theſe eggs is very weak, ſo that in endeavouring to ſeparate them, becauſe they ſtick to each other by a viſcous matter, M. *Leewenhoeck* could not help oftentimes breaking them.

On the laſt of *October*, about five in the evening, M. *Leewenhoeck* obſerved, that another ſpider had made its web againſt the ſides of the glaſs-tube, in order to lodge its eggs there; and whereas, before he could not imagine how the ſpider had placed its eggs in the middle of the glaſs, he was now fully ſatisfied on that matter, for he plainly ſaw that the ſpider made its web like a thick bed againſt the glaſs, that as yet there were no eggs in it; and what was moſt remarkable was, that this bed was not flat, but had a well contrived hollowneſs within, not exactly round, but oval; about 40 minutes after, viewing the ſpider again, found that the ſaid bed was not only full of eggs, but that there was a large heap of them ſtanding above the bed, and the ſpider very buſy in covering them on every ſide with its web, uſing its two hinder feet, as well as its breech to faſten the threads that proceeded from thence, and to range them all in order; all the ſpider's working inſtruments were open, and all of them ſeemed to deliver out thread for the work; ſometimes the ſpider raiſed up its body a ſtraw's breadth, and then removed it as much, that the threads might have a freer paſſage the better to cover the eggs; when the ſpider had laid all its eggs, its body was not the fourth part ſo large as before, and tho' lately ſmooth and diſtended, it was now full of wrinkles and cavities; on the 30th of *October*, M. *Leewenhoeck* carried ſome of the eggs in a glaſs-tube about him, to ſee whether the heat of his body could hatch the young ſpiders, which uſually come out of their eggs in ſpring; but at laſt the moiſture was all exhauſted, and no

young

young ones hatched; from which experiment M. *Leewenhoeck* concluded, that theſe eggs had not been impregnated by the male, as alſo, that all ſpiders, which in the latter part of the year have large bodies, are full of eggs; on the 7th of *November*, he ſaw ſix or eight eggs laid, which did not come out of the hindmoſt part of the body, as in all other animals, but from the upper part of the belly, not far from its hinder legs, where grows a ſort of a hook of a particular figure, which comes partly over the aperture, from whence the eggs iſſue; but in order to be fully ſatisfied in this matter, M. *Leewenhoeck* took ſeveral ſpiders that had not yet laid their eggs, and laying them on their backs, he preſſed their bellies, whereby he not only had a clear view of the aperture, but by ſqueezing a little harder, he forced out ſeveral eggs, but there did not proceed the leaſt moiſture from the hinder part of the body; this experiment convinced him, that that was the place from whence the ſpider diſcharg'd both her eggs and excrements.

Plate II. Fig. 13. A B C repreſents a ſpider of an ordinary ſize, as it lay on its back, with the legs contracted, as if it was dead, in order to ſhew the above-mentioned aperture; D the hook.

Fig. 14. G H I K ſhews the hook ſeparated from the ſpider's body, as it appeared thro' the microſcope; between I and K are ſeen the wrinkles or folds, which M. *Leewenhoeck* imagined were made to produce a more than ordinary motion; E F ſhews the part that joined it to the body; and he does not know, whether the foreſaid hook might not be deſigned to range the eggs in order; in the ſaid Fig. 14. between F and G are two round balls, but he could not imagine their uſe.

January 1ſt, was the third time M. *Leewenhoeck* took a ſpider's eggs, and putting them into a glaſs-tube, he carried them about him; the eggs were laid by the largeſt ſpider he had ſeen laſt ſummer, and it was one of the laſt he could meet with in the gardens; he viewed them ſeveral days without opening, and finding no alteration, which he attributed to the cold weather, he did not look upon them for four days, but upon the 17th of the ſame month, in the morning, viewing them again, he ſaw 25 young ſpiders that came out of ſo many eggs; and about 25 more, whoſe bodies were but half out of the egg-ſhell, and ſome of them had their ſhells hanging on their tail; and in the evening, about 6 o'clock, he reckon'd 150 young ones; the next day he viewed them again, when he concluded that no more ſpiders would come out of the eggs, and that ſeveral which he

he ſaw lying about the glaſs were barren, and that in others, the young ſpiders were dead, the number of which he reckon'd was about 50, and about 10 or 12 eggs were blackiſh; when the glaſs-tube, where the young ſpiders were, had lain out of his pocket but 15 minutes, in very cold weather, he could hardly diſcover any life or motion in ſome of them; but as ſoon as the glaſs was warm'd a little, they were briſk and lively, and moſt of them got together like ſwarms of bees, and ſo hung about the web, where the eggs had been lodged before.

On the 21ſt of *January*, he could perceive the eight eyes in every ſpider, which before were not ſo viſible; but being now of a brown, or darkiſh colour, they were eaſily diſtinguiſhable from the fore-part of their body, which was white, as the hinder part was yellowiſh: Now, if we conſider, what a vaſt number of ſpiders are produced by one, and in how ſhort a time, we cannot conceive whence, or how, they get their food, eſpecially ſince the old ones, as far as M. *Leewenhoeck* could ſee, fed upon nothing but animals; on the 22d of *January*, he obſerved that the legs of ſeveral ſpiders, which had been before clear and tranſparent, did now aſſume a dark colour, and afterwards began to be covered with hair, whereas he could perceive none a little before; on the 23d, their legs grew darker, and ſo did the hinder part of their bodies, whence their web proceeds, which alſo began to be covered with hairs; then he obſerved, ſeveral particles of a watery matter hanging on the ſides of the glaſs, which he had never before taken any notice of; but now there was ſo much of it, that the barren eggs, which before rolled freely about the glaſs, were glewed on to it by this viſcous matter, which ſo much abounded, that the young ſpiders had much ado to paſs thro' it; he likewiſe obſerved, that they had caſt their very thin ſkins, and began to be much nimbler in their motions; the 25th, he ſaw them ſpin a thread, and manage it with their hinder feet, as well as the old ones; he obſerved that they had eat up the barren eggs, and the others, wherein M. *Leewenhoeck* ſuppoſed the young ones were dead, to the number of 50; for a few days after there remain'd nothing, but the bare ſhells.

M. *Leewenhoeck* compared the threads of a full-grown ſpider with a hair of his beard, the thickeſt part whereof he placed before the microſcope, and according to the niceſt obſervation, he judged that above 100 of thoſe threads laid together, did not equal the diameter of a hair of his beard; now ſuppoſing this hair to be round, 10000 of the fine threads of a ſpider's web, are not thicker than a ſingle hair of a man's head; now if we add to

this, as it is moſt certainly true, that 400 young ſpiders, when they firſt begin to ſpin, are not, one with another, bigger than a full-grown one, and that each of thoſe young ſpiders is provided with all the working inſtruments, as the old one, it would follow, that the ſmalleſt thread of ſuch a young ſpider is 400 times ſmaller than that of a great one; and if ſo, then 4000000 threads of a young ſpider are not ſo big as a hair of a man's head; but then again, if we conſider of how many parts one of thoſe ſmalleſt threads conſiſts, we muſt ſtand aſtoniſhed: M. *Leewenhoeck* obſerved, that half the young ſpiders were ſmaller in the hinder part of their bodies than the reſt, which laſt he ſuppoſed to be males; as alſo, that moſt of theſe young ſpiders had bored into the web, and in a manner lodged themſelves therein; which made M. *Leewenhoeck* ſuſpect, that for want of other food they had fed on the web; and the rather becauſe, ſome of them were grown pretty big; on the 30th of *January* moſt of them were employed in weaving their web, ſo that the glaſs ſwarm'd with them; on the 8th of *February*, M. *Leewenhoeck* could perceive that ſeveral of the ſpiders had eat one another up, and at the very time he look'd upon them, there were four that had almoſt devour'd one, and here and there, he ſaw pieces of legs, and at laſt the ſhells of the barren eggs were ſo plainly eat up, that he could ſee nothing remaining of them: On the 10th of *February*, M. *Leewenhoeck*'s ſpiders were reduced to half their number, and ſuch as remained were eating the thickeſt of their companion's legs; theſe ſpiders diminiſhed daily; ſo, that on the laſt of the ſaid month, he could ſee but 30 of them alive; among which a few were 20 times as big as ſome of the reſt; on the 5th of *March*, M. *Leewenhoeck* could ſee but three or four alive, and about the web he obſerved a black matter, about which the ſpiders ſwarm'd very much; and he found that it was nothing elſe, but a heap of legs of ſuch young ſpiders as had been devoured: M. *Leewenhoeck* kept by him the eggs of ſeveral ſpiders in glaſs-tubes, and particularly on the 24th of *January* he put the eggs of two different ſpiders into two diſtinct glaſſes, and on the 6th of *February* he could perceive in one of them three young ſpiders crawling out of the web; he took one, whoſe egg-ſhell ſtill hung at its tail, and ſet it before his microſcope in the open air, and tho' the fore-part of its body was as clear as glaſs, yet he could not perceive the leaſt motion in the inner parts; from whence he concluded, that the heart was not in their breaſt, for had it been there, he muſt needs have

per-

perceived its motion; therefore, he believ'd it lay near the eyes, where it was not ſo tranſparent; for that the expulſion of the blood in a ſpider proceeds from the heart, is, he thinks, not to be doubted: M. *Leewenhoeck* endeavour'd to diſcover the circulation of the blood in the legs of theſe little animals, which obſervation ſucceeded with him ſeveral times; when he caſt his eyes upon the hinder part of their bodies, he could perceive, that their intrails conſiſted of a vaſt many globules of ſeveral ſizes, of which the eggs are compoſed; on the 7th of *February*, M. *Leewenhoeck* could not perceive that there were any more young ſpiders come out of the web, but he ſaw at leaſt 25 egg-ſhells lying without the web; on the 9th of the ſaid month a few young ſpiders were come out of the web, that had caſt their ſkins, and others were crowded together in the web; on the 10th, all the young ſpiders had got out, and ſhed their pellicles, before which time M. *Leewenhoeck* did not believe they endeavour'd to come out; on the 12th of *February* he laid one of the glaſs-tubes upon his desk, to ſee how the ſpiders would fare in cold weather, and next morning he found that moſt of them were crept into their web; but after he had carried them ſome hours in his pocket, he found that they were come abroad again; the 20th, he took two young ſpiders out of the ſaid glaſs-tube, and putting them into another that was thinner, he ſtopped both ends with paper, ſo that they might not get out, and yet have air enough; the 14th of *April*, he perceived that one of the ſpiders lay dead, and the other was very well and lively; but on the 26th, it began to flag in its motion, and next day it was alſo dead, and yet he could not ſee that the one had hurt the other; whereupon, he concluded, that theſe young ſpiders will live more than two months, if it be cold weather without eating.

In the great glaſs-tube, from whence M. *Leewenhoeck* had taken the above-mentioned two ſpiders that had been hatched at the ſame time, there were ſtill (it being then the 26th of *April*) 20 young ſpiders alive, ſitting altogether on the web, which they had ſpun, without once touching, or running about the glaſs, becauſe, as M. *Leewenhoeck* ſuppoſed, the glaſs was too cold for them; and on the 22d of *May*, there were but three of them living, which he could not perceive grown much bigger; the reſt lay by as dead, but moſtly devoured by the longeſt livers; the young ſpiders in the ſecond glaſs tube, which M. *Leewenhoeck* carried about him a long time, did not live near ſo long as the others, the reaſon whereof was, as

M. *Leewenhoeck* thinks, that the warmth of his body cauſed them to perſpire the more, and conſequently, made them ſtand in need of their food the ſooner: He had the eggs of ſix ſeveral ſpiders, which he often viewed, to know when the young ſpiders would come out; and on the 20th of *May*, he obſerved, the eggs change colour a little; and on the 22d, the young ones were hatched, and lay ſo cloſe to one another in the web, that they took up but little more room, than when they were in their ſhells; and M. *Leewenhoeck* could not diſcover any motion in them, only ſuch, as lay outermoſt, moved their legs a little; when M. *Leewenhoeck* took the fleſhy muſcles out of their legs, and view'd them thro' a microſcope, they were very tranſparent, and they ſeemed to be one body; but when he came to ſeparate them, he found that they were compoſed of very long particles, each conſiſting of ſo many *Rugæ* or folds, that the muſcle could be either dilated or contracted, as occaſion required.

Strange Bones *dug up near* Canterbury, *and of the* Iſthmus *that joined* France *and* Britain; *by Mr.* John Somner. Phil. Tranſ. N° 272. p. 882.

MR. *John Somner*, in *September* 1668, ſinking for a well at a new houſe of his at *Chartham*, a village about three miles from *Canterbury*, towards *Aſhford*, on a ſhelving ground, or bank-ſide, within 12 roods of the river, running from thence to *Canterbury*, and ſo to *Sandwich-haven*; and after having dug for that purpoſe about 17 foot deep, thro' gravelly and chalky ground, and two foot into the ſprings, he turned up a parcel of ſtrange and monſtrous bones; ſome whole, and others broken, together with four teeth, ſound and entire, but in a manner petrified; each tooth weighing ſomewhat above half a pound, and ſome of them almoſt as big as a man's fiſt; *Ludovicus Vives* mentions ſuch a tooth, but a little bigger, which was ſhewn him for one of St. *Chriſtopher*'s, kept in a church that bore his name; juſt ſuch another tooth was ſeen by *Acoſta* in the *Indies*, dug out of the ground in one of their houſes there, with ſeveral other bones, which put together repreſented a man of a formidable bigneſs; and ſo muſt we have judged of theſe teeth, and the body to which they belonged; had not other bones been found with them, which could not be human; ſome who had ſeen the teeth, and by ſome other circumſtances, were of opinion, that they were the bones of a *Hippopotamus*, or ſea-horſe; the earth, or mould, about them, and

and wherein they lay, reſembling a ſea-earth, or fulling-earth, without a ſtone, unleſs you dig three foot deeper, and then it riſes a perfect gravel.

Mr. *Somner* ſuppoſes it to have been ſome marine or ſea-bred animal; but how then, will ſome ſay, ſhould it poſſibly come there; and at ſuch a depth under ground too? To which he anſwers. 1. With as little wonder as a land animal ſhould come thither. 2. The mould, ſoil, or earth, wherein it lay, was altogether miry, reſembling the ouſe on ſeveral parts of the ſea-coaſts both in *England*, and abroad; but how can it poſſibly (may ſome ſay) be a ſea-animal, when found at ſo remote a diſtance from the ſea? For the ſolution of this and ſuch like doubts, Mr. *Somner* branches out the argument into theſe four following queries:

1. Whether the ſituation, condition, face, and figure of the place may poſſibly admit of the ſea's once inſinuating itſelf thither?

2. Whether (that poſſibility being granted, or evinced) the ſea did ever actually inſinuate itſelf ſo far, as to reach this place, and when?

3. How, with any probability, and when, this valley or level, being once cover'd with ſea, ſhould come to be quite deſerted and forſaken by it, as it is at this day; the ſea not approaching it by 12 miles, or more?

4. By what means, the ſea having once had its play there, this creature came to lodge, and be found ſo deep in the ground, and under ſuch a ſhelving bank.

1. As to the firſt, *viz.* the aptitude of the place for the ſea's influx or inſinuation; ſuch as know the ſituation, cannot but know and agree that it is ſo; for it is a part of that wide, fair, and fruitful level, or valley, extending itſelf no leſs than 20 miles in length, between a continued range of hills, downs, or high grounds, lying at a pretty diſtance from each other all the way; beginning at the eaſt *Kentiſh* ſhore, and ſtretching weſtward by *Sandwich*, *Fordwich*, *Canterbury*, *Chartham*, *Chilham*, *Godmerſham*, *Wye*, and *Aſhford*, ſometimes in a direct, ſometimes in a winding courſe, as far as that famous ſpacious level of *Romney-marſh*; and is waſhed and watered all along, at leaſt from about *Aſhford*, by a pleaſant river, running thro' the midſt thereof, as far as to *Sandwich*, and there emptying itſelf into the ſea, by the creek or haven; there is no obſtruction at all, by the interpoſition of hills, or high ground, to controul the free play and paſſage of the ſea for ſo many miles together.

If

If any will object that *Canterbury* lies in the way, as an obſtruction or bar, the anſwer is eaſy; for altho' that city ſeems, and indeed is, at this day, for the moſt part ſomewhat elevated above the reſt of the level or valley; yet not ſo much as to defend itſelf many times from floods in the lower, and moſt depreſſed parts thereof; even by the ſprings it ſtands upon, to its great damage and annoyance; towards helping of which, by the care of former ages, it is very certain, and as is daily experimented by digging wells, vaults, cellars, and the like, that the moſt part of this city, not excepting the very heart of it, is made and raiſed ground, the marks of foundations upon foundations, to a very conſiderable depth, appearing daily, and the ground, as at *Amſterdam*, *Venice* and elſewhere, for ſupporting ſuperſtructures, is in ſeveral places often ſtuck and ſtuffed with piles of wood, or long poles and ſtakes, as both well- and cellar-diggers have inform'd Mr *Somner*; nay, and as if the river had ſometimes had its courſe or current, where now the bull-ſtake market-place is kept, pits and other like tanners utenſils have, not many years ago, been met withal in digging for cellars thereabouts; and moreover, Mr. *Somner*'s next neighbour in *Caſtle-ſtreet*, within theſe 30 years, ſinking a cellar, did five or ſix foot deep, light upon a ſtrong and well-couch'd arch'd piece of *Roman* tile or brick, whereof Mr. *Somner* was an eye-witneſs; however then, *Canterbury* may now ſeem to ſtand in the way of the *Æſtuary*; yet time was, when in all probability it did not; when, to wit, the ſoil which the city now occupies, as the reſt of the whole valley both above and below it, was of too low a pitch, to be an obſtacle to it.

2. As to the ſecond enquiry, *viz.* whether probably the ſea ever actually inſinuated itſelf ſo far as this place, and when? The anſwer is not ſo eaſy, for we have no records of it; the beſt and oldeſt account we have of the condition, ſite and conſtitution of theſe our eaſtern parts we owe to *Julius Cæſar*, and the *Romans* after him; from whom we have not the leaſt ſpark of light to ſuch a diſcovery; rather indeed the contrary, both the ſea coaſt, and in-land parts by their relation, bearing in a manner one and the ſame face and figure then as now; however, there are ſeveral *Criteria* or tokens that the level was ſometimes an *Æſtuary* or arm of the ſea; for inſtance, beſides what may be inferred from this parcel of teeth and bones now under conſideration, there is, Mr. *Somner* thinks, much probability for it from the name of their river *Stoure*, very often of old called and written *Æſtur*, or *Eſture*, &c. which Mr. *Somner* does not doubt comes from the *Latin Æſtuarium*, and was in proceſs of time corrupted and con-

ontracted into *Sture* and *Stoure*, giving name in part to *Stour-*
outh-pariſh about ſix miles eaſtward from *Canterbury*, ſo cal-
ed from the rivers diſemboguing there into the ſea flowing up
hither; as alſo giving name to a manor of the Archbiſhop, that
or ſome ages paſt, and to this day is called *Weſt-gate Court*, at
Canterbury, but more anciently, as in the Conqueror's time (wit-
eſs *Domeſday-book*) was called the manor of *Eſture* and *Eſtu-*
eſate, from its ſituation by the *Sture* or *Stoure*; from which
kewiſe, without doubt the lord *Finch*'s ſeat in —— about five
fix miles nearer the ſpring-head, now vulgarly called *Eaſt-*
ward, was of old ſometimes called *Eſture*, at other times *Et-*
ure.

As by the bones and teeth, now under conſideration, we have
inſtance on that ſide of the valley for the probability of the
a's occupying it formerly, ſo Mr. *Somner* gives another from the
ppoſite ſide; by credible relation a place called *Weſtbere*, an
ſcure village about three miles from *Canterbury*, eaſtwards,
ing under the brow of the hill that ſtretches out by *Up-ſtreet*
far as to the weſt end of *Sar-wall*, by which you enter into
hanet, upon the like occaſion as at *Chartham*, viz. digging a
ell, at a very great depth, there were turned up ſtore of oiſters
d ſuch like ſhells, together with an iron-anchor firm, and un-
paired; Mr. *Somner* had been likewiſe told of an anchor dug
at *Broomedowne*, on the ſame ſide of the level ſomewhat
ove *Canterbury*, weſtwards.

3. The third query is, how with any probability, and when
is valley or level, being once ſea-land, ſhould come to be quite
ſerted and forſaken by the ſea, as it is at this day, the ſea not
proaching it by 12 miles or more: In anſwer, Mr. *Somner*
ants, that in caſe this level was once an arm of the ſea, it was
very long ago, that we cannot reaſonably think, that *Canterbury*
whether as a city, or as never ſo mean a village) was then a
ace inhabited, which perhaps it might have been, if not in
ulius Cæſar's days, yet undoubtedly, not long after; for we
ve an account of it, as well as of other places in *Kent*, in the
ne of the *Romans*, both from *Ptolemy* the Geographer, *Anto-*
nus's Itinerary and elſewhere; and we have no elder records of
ritain, that we may confide in as authentic, before the time of
e *Romans*, to help us in this ſcrutiny; we muſt therefore, either
row off all further enquiry, or caſt about for information as well
we can; ſuch as are for the latter tell us, that the world being
ny thouſand years old, manifold are the alterations, which
ne hath made in ſeveral parts; to the notice and diſcovery
whereof,

whereof, no written records, or unwritten tradition at this day, can reach or direct us; of ſuch a nature they conceive this of the *Æſtuary* may be, ſo very ancient, that time hath quite wore out the memory thereof; and a parallel caſe with the preſent, is, that of the ſea's breaking, burſting, and cleaving aſunder that *Iſthmus*, or neck of land, between *Gaul* and *Britain*, which made the latter of the ſame continent with the former; ſuch things, it is certain, have happened elſewhere; thus, ſays *Seneca*, that the ſea had rent *Spain* from *Afric*; as alſo, that *Sicily* was divided from *Italy* by *Deucalion*'s flood; more inſtances of this kind are to be found in *Cambden*'s *Cantium*, and elſewhere; and altho' there be no certain evidence of ſuch an accident here, either from ancient hiſtorians, or geographers, yet the thing is ſo ſtrongly and rationally argued, eſpecially by *Cambden*, as alſo by *Verſtegan*, *Twine*, and others before him; and the conjecture is backed with ſuch plenty of probable *Criteria*, that Mr. *Somner* cannot but be of that opinion; eſpecially, when he has added this one argument, omitted by *Cambden* and the reſt; *viz.* that by a conſtant received tradition, that large and ſpacious level, *Romney-marſh*, containing, according to Mr. *Cambden*, 14 miles in length and eight in breadth, was ſome time ſea, lying wholly under ſalt-water; and is therefore, by ſome not improperly called the ſea's gift; Mr. *Somner* thinks, if he can gueſs at the time, and occaſion of the recovery of both that and *Canterbury-levels* from the ſea, he ſhall pitch upon that of the ſea's breaking thro', and in time waſhing away that *Iſthmus* between *Dover* and *Calais*; and whereas formerly *Romney-level* (which had its *Stoures* of *Æſtuaria* as well as ours) and this other, were but one and the ſame level, and lay under the ſea, becauſe no high lands, interpoſe to impede their conjunction; now both the one and the other (the ſea having ſo much more play than formerly, by cleaving aſunder the *Iſthmus*) were recovered from it, and of an *Æſtuary* became ſuch a rich and noble level or valley, as is ſecond to none in *England*; from hence Mr. *Somner* thinks, might be taken a hint to conſider the *Netherlands* or low-countries, and enquire whether theſe in whole or in part, might not have ariſen out of and be conjecturally aſſign'd for our *Kentiſh* low-lands.

4. As to the fourth query; by what means the ſea having once its play at *Chartham*, this creature comes to lie ſo deep in the ground, and under ſuch a ſhelving bank? To this it may be anſwered, that ſuppoſing this with the reſt of the level or valley to be once occupied by the ſea, that being a creature, which by the flux and reflux is always in motion, and thereby in time beating

beating upon, and working itſelf into the bank, or riſing ground, might at length ſo far undermine and looſen it, as to fetch down ſo much mould or earth over the place, as to lodge itſelf at ſo great a depth; or elſe perhaps, the continual agitation of the water might in time force, drive up, and caſt over it, that great quantity of ouſe, earth, and other matter, under which it lay; by the way, it is obſerved, that the nature of the ſoil, is ſo looſe, ſupple, rotten, and ſandy, that merely of itſelf, it is apt to ſink, and fall in; as was lately experienced by a ſaw-pit dug hard by, which ſoon after, by the earth's giving way on each ſide thereof, fell in and filled it up.

Hydatides *voided with the* Urine; *by Dr.* Davies. Phil. Tranſ. N° 273. p. 897.

A Gentlewoman between 40 and 50 years of age, drank ſome aluminous water for four or five weeks in autumn, and in a month's time after the uſe of theſe waters, ſhe found a pain in the renal region, where ſhe had never been afflicted with any before; this pain returned, after the firſt paroxyſm, in about a month's time, and afterwards more frequently, till about the *Chriſtmaſs* following; it viſited her every day, about which time ſhe ſent for Dr. *Davies*; ſhe had, when he came to her, the ſymptoms of a ſtone in her left kidney; *viz.* a grinding, and ſometimes a very acute pain on that ſide of the *Spina dorſi*, a vomiting, her urine during the paroxyſm tinged with blood, and therein bloody *Ramenta*; but what was moſt ſurpriſing, was a dozen, at leaſt, of *Hydatides*, ſome of the largeſt were an inch and a half long, and their circumference equalled that of an ordinary gooſe-quill; they exactly reſembled the ſhape of the *Veſiculæ Natatoriæ* in fiſh, becoming ſmaller about the middle, as thoſe generally do; and were filled with a liquor, which, by its taſte and ſmell, made the Dr. take it to be urine; he never diſcovered any purulent matter in her urine, nor had ſhe any pain in the ſphincter of the bladder, nor in the *Meatus urinarius*, either before, at, or after making urine; the paroxyſm laſted generally three or four hours; as ſoon as theſe *Hydatides* came away (which they did not all at once making water, but at ſeveral times) the pain in her back, *&c.* abated very ſenſibly, and ſhe continued eaſy and well the reſt of the day, excepting an external ſoreneſs, which the pain had cauſed; the Dr. took theſe *Veſiculæ* to be at firſt membranous, ſince their conſiſtence was ſo tough, as to bear taking out of the chamber-pot, and gentle handling; but he was afterwards convinced, that they

owed their origin to a glutinous ſlimy matter; becauſe, upon ſtanding long in fair water or urine, they quite diſappeared, and were diſſolved, making the urine or water look thick and turbid; by the uſe of medicines all theſe ſymptoms diſappeared, and ſhe continued well.

The Cauſes of the different Taſte of Water; *and the Edges of* Razors; *by M.* Leewenhoeck. Phil. Tranſ. N° 273. p. 899.

M. *Leewenhoeck* took a drop of rain-water that was well boiled in a tinn'd water-kettle, with a good cover on it, ſo that no ſmoak could get in; this water being moſtly exhaled, there remained abundance of little ſalt particles of an oblong quadrangular figure, whoſe thickneſs was almoſt equal to their breadth, and the upper parts of ſeveral were pointed like ground and poliſhed cryſtal; but when he viewed them more narrowly, he perceived that from every angle there ſtood out a point.

Plate II. fig. 15. A and B repreſent two of theſe ſalt particles, wherein M. *Leewenhoeck* could perceive none of thoſe points, that are plainly to be ſeen, fig. 16. between C D and E, and where there were ſeveral, otherwiſe very like fig. 15, A B: Afterward M. *Leewenhoeck* took ſome rain-water, that was juſt ready to boil, ſo that he could ſee ſeveral air-bubbles riſing from the bottom of the kettle; and after he had alſo exhaled this water, he diſcover'd abundance of the aforeſaid ſalt particles, and in as large a quantity, as in the other water, that had been well boil'd; but beſides theſe, there were a few ſalt particles in ſhape like fig. 17 F G and H, of which latter ſort he could diſcover none in the water that was boil'd enough; from whence M. *Leewenhoeck* concluded, that theſe ſalt particles, which give the unboil'd water an unpleaſant taſte, might very probably be thoſe we call the volatile ſalts, which by a great deal of boiling, are diſlodged or evaporated out of the water.

M. *Leewenhoeck* had five new *Engliſh* razors brought him, which he viewed with his microſcopes and found abundance of ſmall notches in them, ſome of theſe were pretty large about the point; and in one of them, cloſe to the edge, he obſerved a little hole he could ſee through; ſo that if the razors had not been very clean, and laid in oil, he would have imagined that ruſt had been the cauſe thereof; out of thoſe five razors M. *Leewenhoeck* choſe one, which ſeemed to him to have the feweſt notches, and with that he cauſed himſelf to be ſhav'd; at firſt, it was very ſoft and eaſy, but at laſt it grew ſo painful that he could not endure it, and viewing the razor he found in it many more notches than at firſt

firſt; M. *Leewenhoeck* took one of his own razors, which tho' it could cut pretty well, and he could uſe it in ſhaving, yet it was ſo full of notches, that one would wonder how it could cut a hair without cauſing pain; he took another, which he did not value much, and had uſed but very little, ſince it had been ground; he obſerved the back to be pretty ruſty, but the edge had little or none; he ſcraped the ruſt off, and ground the razor with a grindſtone, in order to get off the ruſty part about the edge; then he paſs'd it over a ſoft hone with water, to grind out the ſmall notches the firſt ſtone had left, and make the edge the finer; he paſs'd it once or twice thro' oil, after which he look'd upon it thro' his glaſs, and obſerved, that in ſix ſeveral places cloſe to the edge, there were little holes quite thro'; and tho' with the naked eye one could perceive but a very little ruſt, and that only in one place, yet M. *Leewenhoeck* could ſee very plainly with his microſcopes, that all thoſe little holes were full of ruſt, which had eaten thro' the razor; he waſh'd the back of his hand with plain water, and then took the ſaid razor, and therewith ſcraped off the little hairs; then obſerving the razor again, he could perceive that thoſe little holes were turn'd to notches, and that ſmall pieces of the razor were broken out; M. *Leewenhoeck* obſerved ſeveral notches in a razor ground at another place, and never uſed, and ſtill more, in another that had been uſed, and reckon'd a very good one; and he is of opinion, that if the metal of the razor be too ſoft, it yields to the hair; and if it be too hard, the hair cauſes ſeveral notches in it, and eſpecially, when the razor meets with a ſtiff rugged hair, that was not ſufficiently ſuppled with water; however it be, he never ſaw a razor without ſome notches.

Microſcopical Obſervations, *by the Same.* Phil. Tranſ. N° 273. p. 903.

M. *Leewenhoeck* was ſhewn a magnifying glaſs, whoſe chiefeſt excellency was, that one could ſee an object a great diſtance from it; as ſoon as M. *Leewenhoeck* put the ſaid glaſs to his eye, he concluded there was a hole or cavity in it, by which the remote object came to be ſeen, and viewing it by one of his own glaſſes, he not only diſcover'd one deep pit or cavity in it, but ſeveral other leſſer pits, which had not been ground out; a certain glaſs-grinder came to M. *Leewenhoeck* with a magnifying glaſs, whereby he ſaid, he could ſee into metals and minerals; but M. *Leewenhoeck* anſwering, that the pores of metals were ſo cloſe and impervious, that it was impoſſible ever to ſee thro' them, not

even thro' leaf-gold, tho' beat ever ſo thin; upon which he put the glaſs into M. *Leewenhoeck*'s hand, adding, that he might ſee the light of the candle thro' a copper circle, which ſtood before the magnifying glaſs, and accordingly he ſaw a very faint light thro' the copper circle; which phænomenon was only occaſioned by a ſmall part of the glaſs that was not ground, as M. *Leewenhoeck* diſcover'd by an extraordinary magnifying-glaſs.

It ſometimes happen'd that ſmall particles by the burſting of glaſs, or ſparks flying out of wood-coals, had got into M. *Leewenhoeck*'s eye, and cauſed it to ſmart, upon which he uſed to arm his eyes with ſpectacles; now he obſerves, that when he looks thro' one of his glaſſes by candle-light, that near the upper part of the eye in the *Tunica cornea*, there appears a fine ſmall flame of a candle inverted; and oppoſite thereto, two round clear lights, ſo very ſmall, that the flame of the candle is not to be perceived therein; from hence M. *Leewenhoeck* concluded, that the *Tunica cornea* had loſt, by the wound received from thoſe particles of glaſs, ſomewhat of its roundneſs, which occaſioned thoſe appearances, and that when the wounded part ſtood juſt before the ſight, it obſtructed it, *&c.* He alſo obſerv'd, that in ſeveral places of the *Tunica cornea*, there lay veins no longer than the breadth of two or three hairs put together, wherein he could perceive the globules of blood very diſtinctly; theſe veſſels were ſo ſmall in their diameter, that they could contain but one globule, and the blood had no motion; the veſſels ſeem'd to M. *Leewenhoeck* to be broken off from other blood veſſels; and when the particles of blood are a little crowded together, or when one of thoſe longiſh veſſels are ſomewhat bended, it appears to the ſight, as if one ſaw a thick cloud; the eyes are ſurrounded with this cloud of ſmall particles, but more at one time than another, for ſome are diſperſed, and then others ariſe in their ſtead; upon viewing theſe veſſels with their globules of blood thro' a microſcope againſt a candle, or other ſtrong light, they ſeemed to be in continual motion; whereby thoſe particles, that are in the *Tunica cornea*, be their motion never ſo ſmall, ſeem to us, as if they were moving in the air; but by a ſtrict examination we ſhall find, that they are one and the ſame particles, which ſometimes appear aſcending, and at other times deſcending; beſides, we find in the *Tunica cornea* round particles that lie ſcatter'd about, which M. *Leewenhoeck* judged to be globules of blood; it has often happen'd, when he look'd thro' his microſcopes againſt a ſtrong light, that he ſaw a vaſt number of exceeding ſmall particles, that had all a glittering motion; which M. *Leewenhoeck* takes to be in the cryſtal-

ryſtalline humour of the eye, between the *Tunica cornea* and *ryſtallina*, and their Motion is occaſioned by preſſing the *unica cornea*, when we ſhut our eyes cloſe together.

M. *Leewenhoeck* had often taken ſeveral ſorts of moiſt ſubances, and laid them on a very clean glaſs and viewed them, alſo his breath thro' a microſcope, when he could ſee their ne ſubtile particles riſe up from the glaſs like clouds, and at ſt quite vaniſh, ſo that he could not perceive the leaſt remnt thereof; and he is abſolutely of opinion, that tho' he uld ſee the *Effluvia* of bodies, that were a thouſand milons of times ſmaller than thoſe, yet he could not perceive the erſpirations of bodies, and much leſs the imaginary influens of the ſtars.

A New kind of Walnut-tree *by M.* Reneaume. Phil. Tranſ. N°. 273. p. 908.

THE *Nux Juglans ſive Regia*, or walnut-tree, has been deſcribed by ſeveral authors, who ſeem to have known t fix ſpecies thereof, tho' M. *Reneaume* can reckon nine; ey confounded with the common ſort, that which the country ople call *Noix Angloiſes* which may be diſtinguiſhed by the me of *Nux Juglans putamine duriſſimo*, which appear to . *Reneaume* to be the ſame with what in *Hermolaus* and the *iſtoria Lugdunienſis* is called *Moratiæ moracillæ*, and which *eſalpin* calls *Surdæ:* Beſides, the ſame authors have not diſguiſh'd another ſpecies, which might be called *Nux Juglans uctu præcoci*, becauſe they are ſooner ripe than the others, d eaten about the feaſt of St. *Jonh en Cernaux*, which has ven them amongſt the country people, the name of *Noix annettes*; as for that ſpecies M. *Reneaume* is to treat upon, cannot find any author that knew of it, and therefore he lls it *Nux Juglans, folio eleganter diſſecto* or *Acanthilia*.

The oil which is preſſed out of the walnut-tree in certain ovinces, is uſed inſtead of butter and olive-oil; in *Berry*, here they have very good wool, and where they trade very uch in cattle, yet they have but very little butter, and that tle which they have is worth nothing, and is very dear; ſo at they uſe nut-oil in dreſſing their meat; for this reaſon, ere is a vaſt number of walnut-trees planted in the middle the plow'd lands, in ſuch a manner, that afar off one would ke theſe lands for woods of walnut-trees; the want of theſe es in this country obliges the inhabitants to cultivate them, which

which they do in particular places, as in a ſort of nurſery, in order to plant them afreſh, when they die, whether it be of age, which is rare, or whether they decay, or are fell'd for timber to work withal; in autumn, M. *Reneaume* being in an orchard two leagues from *Selles* in *Berry*, where they bred up a vaſt many walnut-trees, he perceived in the middle a ſort of leaf, or foliage he had never ſeen before, and which he examined; and by the taſte, ſmell, wood, and figure of the tree he concluded it was walnut, tho' he did not remember ever to have read, or heard of any ſort like it; the tree was very young, and never bore any fruit, perhaps, becauſe it was in a manner choak'd up, and that there was neither air, nor nouriſhment enough, by reaſon of the great number of other walnut-trees, which grew round about it; it was near ſix foot high, and two inches in diameter at the bottom; it was adorned at top with ſeveral branches, and, as the country people ſaid, it was about 8 or 9 years old, and they had always found its leaves, like thoſe M. *Reneaume* ſaw: The common walnut-tree bears its leaves by pairs, upon a ſtalk which terminates in a ſimilar leaf, that is ordinarily bigger than the reſt; and it has very ſeldom above three pairs upon each ſtalk; this ſort had ſometimes four or five pairs, and ſometimes more, which are one while oppoſite, another while alternate, tho' its leaves appear ſmaller, than thoſe of the common walnut-tree; becauſe, of the cuttings or ſlaſhes; yet they are nevertheleſs as big, taking their circumference from the extremities of theſe indentures or ſlaſhes; the firſt pair, and ſometimes the ſecond are leſs cut than the reſt, being ſo only on the circumference; but the others are cut ſo deep, that it looks, as if the nerve in the middle of the leaf was only a ſtalk; and the cuts of the leaves are ſometimes by pairs, other times ſingle on one ſide; theſe leaves are ſometimes forked at the extremity, and at other times they end in a point; in ſome places it looks, as if the leaf was torn on purpoſe, almoſt like the *Angelica Canadenſis*, *foliis quaſi Præmorſis*; there are others that ſeem to be double, as if the ſtalk or the nerve was winged, juſt like the winged ſtems or *Caules alati*; all theſe cuts and ſlaſhes are not like indentures, but end in a round; and notwithſtanding all theſe irregularities, they look like thoſe wrought leaves, which ſerve for ornaments to painters, almoſt reſembling thoſe which adorn the capital of the *Corinthian* order, or what in heraldy they call *Mantles*, or what the botaniſts call *Acanthus* or *Brancurſin*: *Delechamp* has obſerv'd an aerial honey of

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yellowiſh colour, upon the leaves of a walnut-tree, which can be nothing but an effect of its perſpiration, as is found in all other trees.

The Asbeſtus, *and the Manner of ſpinning and making an* Incombuſtible Cloth *thereof, by* Signior John Ciampini. Phil. Tranſ. N°. 273. p. 911.

S. *Ciampini* mentions four ſorts of the *Asbeſtus* ſtone, of which he had ſpecimens in his *Muſæum*; the firſt was ſent him from *Corſica* or *Corfu*; which was long, of a woody, form, and half a palm and more in length, of a whitiſh colour ſomewhat inclining to a reddiſh; the ſecond ſort is of a ſilver colour, ſofter and ſhorter, about three inches long, from *Seſtri de Ponente* in *Liguria*; the third, which is the worſt of all, reſembles ſcales or *Laminæ*, one upon another, like an onion, of a blackiſh earth colour, with ſome white, black, and dark red veins interſperſed, ſcarcely two parts of a *Roman* inch long, and therefore it is fitter for making of paper, than for ſpinning or weaving; the fourth ſort was given him by S. *Boccone*, and found in the *Pyrenees*, ſome of which was a *Roman* palm long; its filaments, tho' longer, were yet thicker and rougher; he alſo ſays, that he heard of another ſort in *Montibus Volateranis*, and afterwards quoting ſome paſſages out of *Pliny*, *Dioſcorides*, and other authors, that have mention'd this ſtone, and the cloth made thereof, he touches upon its ſuppoſed uſe for the wicks of ſepulchral lamps, and from ſome experiments, he concludes it unfit for that purpoſe, having always found the wicks made of it go out, and not attract the oil for the flame; next, he tells us, he had kept it for three weeks in a glaſs-houſe fire, but he found it unaltered, tho' it would not preſerve a ſtick wrapt in it from the fire, from whence he concludes that the *Amianthus* loſes nothing in the fire, becauſe it does not burn, nor flame, but in the handling it waſtes, tho' not much, as he found by an exact ballance; laſtly, he proceeds to ſhew the manner of ſpinning it, which he tried thus; firſt, the ſtone is laid in water (the warmer the better) for ſome time to ſoak; then it is open'd, and divided with the hands, that the earthy parts may fall out, which are whitiſh like chalk, and hold the thready parts together; this makes the water thick, and milky; and this is repeated ſix or ſeven times with freſh water, where it is again open'd, and ſqueezed, till all the heterogenous particles are waſh'd out, and then the flax-like parts are collected, and laid in a ſieve to dry; after which lay the *Amianthus* between two cards, ſuch as

as wool is carded with; where let it be gently carded, and then clapt up between the cards, ſo as that ſome of it may hang over the ſides; then lay the cards faſt upon a table or bench, take a ſmall reel made with a little hook at the end, and a part to turn it by, ſo that it may eaſily be turn'd round, this reel is to be wound over with fine thread, then having a ſmall veſſel of oil ready, with which the fore-finger, and thumb are conſtantly to be kept wet, both to preſerve the ſkin from the coroſive quality of the ſtone, and render the filaments thereof more ſoft and pliant; thus by twiſting the thread about upon the reel, with the *Aſbeſtus* hanging out of the cards, ſome of it will be worked up with it; by little and little, this thread may, with care, be woven into a coarſe ſort of cloth, and by putting it into the fire, the thread and oil will be burnt away, and the incombuſtible cloth will remain: But finding this way of uniting the ſtone with the thread very tedious, inſtead of the thread, he put ſome flax upon a diſtaff, and by taking three or four filaments of the *Aſbeſtus*, and mixing them with the flax, he found they might eaſily be twiſted together, and the thread made thus, be much more durable and ſtrong; ſo that there is no need of carding, which rather breaks the filaments, than does any good, only after waſhing, open and ſeparate the filaments upon a table, and take them up with the flax, which is ſufficient: Of his four ſorts of *Amianthi* S. *Ciampini* found that from *Corſica* the beſt, being long and ſoft; and the *Cyprian* ſort the worſt; tho' he doubts whether his was of the beſt ſort, ſince the *Cyprian* is commended by *Pancirollus*, and others he quotes: As to the making of paper, he ſays, in waſhing the ſtone there will remain ſeveral ſhort pieces in the bottom of the water, and of theſe, paper may be made after the common method.

He concludes with the beſt way of preſerving the cloth, or any other thing made of the ſtone, for by reaſon of its exceeding dryneſs, it is very apt to break and waſte; which is by always keeping it well oiled, the only preſervative for it, and when the cloth is put in the fire, the oil burns off, and the cloth comes out white and purified.

Some large Bones *found in a* Gravel-pit *near* Colcheſter; *by Mr.* John Luffkin. Phil. Tranſ. N°. 273. p. 924.

IN digging for gravel there was found at *Wrabneſs*, a ſmall village, ſituated in the moſt eaſtern parts of *Eſſex*, upon the river *Stowe*, near *Harwich*, divers bones, of an extraordinary

inary bigneſs, at fifteen or ſixteen foot beneath the ſurface of he earth.

We read in *Cambden*, p. 351, that in the time of King *Richard* I. and in the reign of Queen *Elizabeth*, there were found in he moſt eaſtern promontory of *Eſſex*, at a place called *Odul-neſs*, which Mr. *Luffkin* takes to be *Walton*, large teeth, and ones of an extraordinary bulk, which were eſteem'd giant's ones; but Mr. *Childrey* in his *Britannia Baconica*, p. 100. ather thinks them to be the bones and teeth of ſome elephant, uried there by the *Romans*, and Mr. *Luffkin* is apt to believe he ſame; 1. Becauſe, they far ſurpaſs in magnitude the bones, *&c.* of the largeſt animals we have at this day in our iſland. 2. Be-uſe it is evident from *Dion Caſſius*, as quoted by Mr. *Cambden*, his *Britan.* p. 347, that a great number of elephants were rought over into *England*, by the Emperor *Claudius*, in his ars with the *Britons*; yea, into *Eſſex* itſelf, as appears from he ſame *Dion* a little after in theſe words; Claudius *hav-g at laſt joined* Plautius, *and taken the Command of the rmy, paſs'd the River, meaning the* Thames, *and upon a ir Engagement with the Enemy, who were poſted there to eceive him, obtained the Victory, took* Camolodunum, *&c.* In comparing this bone with the oſteology of Dr. *Mullins* his anatomical account of the elephant burnt at *Dublin*, &c. r. *Luffkin* found that it perfectly agreed with the *Os humeri* ereof, not only as to outward appearance, but alſo as to eaſure; from which circumſtances we may conclude, that eſe were the bones. *&c.* of ſome elephant, rather than any other animal; and it ſeemingly appears to Mr. *Luffkin* at theſe bones and teeth mention'd by Mr. *Somner*. Phil. ranſ. N° 271. might have been thoſe of ſome elephant, rather an of the *Hippopotamus*; and that, 1. In reſpect to the place; r as Mr. *Cambden* ſays in his *Britannia* p. 197. ſpeaking of *ilham* in *Kent*, of which this *Chartham* is a neighbouring llage, and ſituated in the ſame down, and on the ſame river *owre*; that it is a current report amongſt the inhabitants that *ulius Cæſar* incamp'd there, in his ſecond expedition againſt e *Britons*, and thence it was called *Julham*, as if one ſhould y, *Julius*'s ſtation or houſe; it appears further, *Britan.* 208 that *Rhatupiæ* (which whether *Richborough* or *Stoner* atters not) ſituate near *Sandwich*, was the place of *Claudius*'s nding in *Britain*; and that thro' this *Down* was his neareſt ay to the *Thames* (is indiſputable) whither he was going; that it is highly probable, that during the ſtay, paſſing, or

repaſſing of the *Roman* armies through theſe *Downs*, one of their elephants might periſh or die, and be buried there. 2. By the teeth themſelves compar'd with the deſcriptions of *Mullins*'s. *Anatom.* p. 40. You find them the very ſame, as to breadth, depth, and their being *Molares*. 3. And laſtly to ſolve that great difficulty, which obliged Mr. *Somner* to imagine this *Down* to have been an *Æſtuary*, that his *Hippopotamus* might therein dig itſelf a grave; otherwiſe, ſays he, how ſhould theſe bones be found at ſuch a depth? Or who with reaſon can imagine, that any land animal could ever have had at firſt ſo deep a burial? But, it is eaſily explain'd, why theſe bones ſhould at this day be found at ſuch depths, if we conſider the alteration, or riſing of the valleys, by the continual waſhing down of the looſe earth, or ſoil by rains, and ſnows from the neighbouring hills, and by the annual rollings of the graſs, ſedge, *&c.* growing upon it; for proof whereof, take the following inſtance from Dr. *Plot's Nat. Hiſt.* of *Staffordſhire*, Ch. vi. p. 48. p. 220. ſpeaking of a moſs, *&c.* wherein there was found a parcel of coins of *Edward* IV of *England* (ſuppoſed to have been loſt in a purſe, or cloth, now rotted away) at a foot depth, which being about 200 years ſince they were found; by computation this moſs grew about a foot in 11 years, or an inch and nearly a twelfth part of an inch in a year; divers other inſtances of alteration are mention'd in the ſame hiſtory, as in *Ch.* 3. *par.* 11. 12. and *Ch.* 6. *par.* 45, 46, 47, &c. Now it will eaſily be granted, that if this moſs grew above its former ſurface 18 foot in 200 years, conſequently this vale, or *Down* might advance itſelf 17 foot in almoſt 1700 years.

The Indian Varniſh; *by Dr.* Joſeph del Papa. Phil. Trans. N° 274. p. 947.

THE uſing and the handling of the *Indian* varniſh; or lacker, ſo far as it is neceſſary to lay it on ſubjects to be varniſhed, having produced ſuch extraordinary effects on Sig. *Ignatio*, and more remarkably on his maid-ſervant; as great ſwellings of their heads, eyes, arms, and indeed almoſt of their whole bodies, with an intolerable itching, inflammations and pimples, may well excite our curioſity to ſearch into the reaſon of this extraordinary *Phænomenon*; and the rather that among the numerous ingredients of the *Materia medica*, and other natural ſubſtances, there is not one that produces an alteration equal, or ſimilar, to what this does in human bodies; all our liquors, and corroſive ſpirits only affect the parts of the body

body they immediately touch, and diffuſe not their miſchie-
ous qualities over the whole body, as this varniſh does;
oiſonous fumes, or ſteams from mercury, or antimony, mani-
eſt their malignity on the brain, and nerves, by great and in-
urable diſorders, whereas the effluvia and touch of this
arniſh affect only the external ſkin of the body; and tho' in
very ſtrange manner, yet not deſtructive of the part af-
ected, which grows well again of itſelf; there are, indeed,
me juices of roots, and herbs, and other parts of vegetables,
hich by touching our fleſh, either inflame, or exculcerate it,
r produce ſwellings, puſtules, and itchings, but all theſe
auſe the diſorder only where they touch, and do not ſpread
heir inviſible venom over other parts of the body: In fine,
Dr. *del Papa* does not know an inſtance of any one thing,
hich either touch'd with the hand, or inſinuating itſelf by
s fumes, or vapours into our body, is able to produce almoſt
ver the whole ſkin, inflammations, ſwellings, itching, and
uſtules, as if the whole body were ſtung with a vaſt number
f waſps, or gad-bees, for ſuch exactly are the effects produ-
ed by this varniſh.

The great difference between this, and all things elſe, and
he ingredients whereof it is made, being abſolutely unknown,
ender it impoſſible to penetrate into the true cauſe of the
bovementioned effects; yet we may propoſe it as a probable
onjecture, that this varniſh contains ſome ingredient, which
hen hot, emits into the body a ſubtile vapour, which only
ffects the ſkin, without touching any other part; after the
me manner, *Cantharides* not only taken inwardly, but out-
ardly applied, communicate a venomous quality of a par-
icular nature, affecting only the kidneys, bladder, and urinary
aſſages, cauſing ſenſible pains and excoriations therein, with-
ut affecting the other *Viſcera* in the leaſt; ſome phyſicians
re of opinion, that this particular diſagreement of *Cantha-
ides* with the urinary ducts, is occaſion'd by the ſalt, and nitre
ontained in the urine, which give life, and vigour to the
oiſon of the *Cantharides*, without which ſalt their poiſonous
uality could have no power; ſo after the ſame manner, it
ay be ſaid, that the noxious fumes of the varniſh become
urtful to the ſkin, by mixing with ſome juice they meet with
herein, eſpecially in the milliary glands, whereof the whole
kin is full: It is certain, that the varniſh exerts all its malig-
ity on the ſkin, the *Viſcera* and blood being untouched, and
he Dr. obſerv'd that the maid (at the ſame time that almoſt

her whole ſkin was hard, inflamed, ſwelled, and full of pu
tules) had yet no fever, head-ach, nor any inward ailment; an
as to what diſorders Sig. *Ignatio*, or ſhe felt in their eyes, th
was a ſwelling affecting the eye-lids only, which may be reckon
as parts of the ſkin; but it is poſſible, the bad effects of th
varniſh were more ſenſible and troubleſome in that part, a
the ſkin there is thinner, and more delicate than on the reſt
the body; this varniſh, therefore, is only an enemy to the ſki
and to produce this effect, it is not neceſſary that the varni
be heated; for, tho' cold, it emits the ſame noxious ſteam
which inſinuate themſelves into the body, eſpecially wh
touched and handled.

Dr. *Del Papa* had ſeveral times ſpread a great deal of th
varniſh, hot upon the naked ſkin of poultry, and they nev
received any hurt from it, either internal or external; he al
made other fowls ſwallow crumbs of bread ſopp'd in the varni
and they ſeemed to like it very well; others he pricked in th
breaſt, till the blood came, and then anointing them all ov
with this varniſh, inſtead of hurting, it proved a balſam t
heal them; it is poſſible, that this varniſh does not produ
the ſame effects on the very thin ſkin of fowl, as on that o
men, becauſe they are very different from each other, both i
their ſtructure, and in the quality of the humours contained i
them: The Dr. obſerved that this varniſh is in a great me
ſure compoſed of gummy, and unctuous matter; for it is ver
light, ſwimming upon brandy and oil, and not uniting eith
with water, or ſpirits of wine, or any other liquor, but o
alone; and beſides, it burns, or takes fire; for the Dr. dipp
cotton therein, which burnt all away to aſhes, tho' at fir
there was ſome difficulty to make it take fire, which might b
owing to the admixture of ſome other ingredient, that was n
unctuous; and laſtly, its compoſition, when obſerved with th
microſcope, appears like that of oil, or lard, or ſome ſuc
unctuous ſubſtance; and from all theſe circumſtances, it i
probable, that it conſiſts of the gum, or juice of ſome reſino
herb, or tree, or of the fat of ſome animal, or hog's lard; an
poſſibly the gall of ſome animal may be mix'd therewith, t
make it the more eaſily receive a ſmoothneſs and luſtre, a
limners uſe to put gall to their water-colours, to make the
run, and ſpread the better; and that the miſchief, which i
found by touching, and uſing it, may proceed from hence
The Dr. is perſuaded, that their is no mercury in this varniſh
not only, becauſe it is very light, but becauſe he had bee
ver

very careful in trying, whether gold would diſcover any ſigns of mercury, either in the body, or ſmoke thereof, but in vain; and beſides, mercury produces very different effects in our bodies, from thoſe of this varniſh: The Dr. obſerved, that the varniſh mix'd with ſpirit of vitriol, or juice of lemons, or vinegar, or ſpirits of wine, cauſes no ebullition, nor change of colour; but when taken out of the veſſel, and expoſed to the air, it readily changes colour, becoming at firſt reddiſh, and afterwards almoſt quite black; the outward ſkin next the air becoming very hard and black; this ſkin is very thin, under which the reſt of the varniſh remains ſoft and fluid, of the colour, and conſiſtence of honey; and as often as you take off this outward and hard black ſkin, there will be form'd immediately another like the former, and this as often as you pleaſe to repeat the experiment; ſo that the whole ſubſtance of the varniſh will in time, be changed into theſe hard and black ſkins: In fine, this known quality of the varniſh is worth obſerving; for, having ſpread ſome of it on the naked breaſt of ſome fowl, and leaving it there for three days, the Dr. afterwards found, between the dried varniſh and the fleſh, the place all feſtered, and full of a yellowiſh *Serum*, but without any further harm; the Dr. attempted the ſame thing on dogs and cats, but without ſucceſs; for theſe animals ſoon take off the varniſh with their tongues and claws, and ſo receive no hurt by it; perhaps, the experiment might ſucceed better on horſes, and ſuch like animals, if the varniſh has the ſame corroſive or cauſtic quality on their bodies, that it has on poultry.

Obſervations on thoſe Solutions *and* Fermentations, *which may be denominated Cold; and a new* Thermometer; *by M.* Geoffroy. Phil. Tranſ. N° 274. p. 951.

THE different reſearches M. *Geoffroy* made into the nature and properties of ſalts, together with the different experiments he tried, in examining their ſolutions or mixtures in certain liquors, gave him occaſion to obſerve, that the mixture of the greateſt part of ſalts in ſeveral liquors is attended with a ſenſible coldneſs, notwithſtanding the prompt, and violent fermentations, which enſue on ſeveral of theſe mixtures; M. *Geoffroy* diſtinguiſhes theſe ſolutions, or mixtures, into two claſſes; the former comprehends all the ſimple cold ſolutions, that is, ſuch as are not accompanied with any ſenſible fermentation; the ſecond only takes in the cold ſolutions of ſalts, which are attended both with a ſenſible fermentation, and a coldneſs of the liquor.

Claſs

Claſs I. Of ſimple cold Solutions.

M. *Geoffroy* put a pint of common water into a phial, and an ordinary thermometer of 18 inches in the water, and ſo let it lie for ſome time to fit itſelf to the temperature of the water; he afterwards put into the water 4 ounces of *Sal Armoniac*, and the liquor in the thermometer deſcended 2 inches and 9 lines, in leſs than a quarter of an hour; obſerving the ſame circumſtances, he made the ſame experiment with ſalt-petre, and the liquor in the thermometer deſcended 1 inch and 3 lines; the ſame experiment being made with vitriol, the liquor in the thermometer deſcended almoſt an inch; ſea-ſalt made the liquor deſcend but 2 lines; all the *Alcaline* volatile ſalts cool'd common water by their admixture, cauſing the liquor in the thermometer to deſcend ſome lines; but M. *Geoffroy* obſerved, that they cauſed it to do ſo more or leſs, according as they were more or leſs purified; and ſalt of urine ſeem'd to do ſo ſooneſt of all; as for the *Alkaline* lixivious ſalts, they were ſo far from cooling the water, that they heated it more or leſs, according as they were more or leſs calcined: Upon the whole, one may obſerve, that the ſalts for heating the water ought to be purely alkalious; for if they approach near the nature of nitre, or ſea-ſalt, they heat the water but little, or not at all, or rather cool it; this is alſo done very conſiderably by ſalt of tamariſc, extracted from the *Lixivium* of the aſhes of this vegetable; *Sal Armoniac* mixed with vegetable acids, as diſtilled vinegar, juice of lemons, or verjuice, gave no ſigns of fermentation, but cool'd theſe liquors very much; an ounce of *Sal Armoniac* caſt into 4 or 5 ounces of diſtilled vinegar, cauſed the liquor of the thermometer to deſcend 2 inches and 3 lines; the ſame ſalt, mixed with the juice of lemons, cauſed the liquor to deſcend 2 inches; it does the ſame with verjuice.

Claſs II. Of cold Fermentations.

Salt-petre caſt into its acid ſpirit, raiſed ſome ſmoke, or vapours, and cauſed the liquor of the thermometer to deſcend 4 lines; from ſaltpetre, mixed with the ſpirit of vitriol, there exhaled a great quantity of ſmoke, which made the liquor deſcend from 6 to 7 lines; in theſe two experiments M. *Geoffroy* put half an ounce of ſalt to 3 ounces of liquor; he put half an ounce of *Sal Armoniac* into 3 ounces of ſpirit of nitre, and the liquor in the thermometer deſcended 3 inches and 5 lines; this mixture emitted ſome vapours, which ſeem'd more conſiderable, than thoſe which ordinarily exhale from ſpirit

ſpirit of nitre alone; he pour'd half an ounce of *Sal Armoniac* into 3 ounces of ſpirit of vitriol, which made a violent fermentation; the matter was conſiderably raiſed, and much vapour exhaled, the liquor was very thick, and the thermometer fell inches and 6 lines; he obſerved, that the vapours exhaled by this mixture were hot, and that they raiſed conſiderably the liquor of the thermometer, which he held hanging over the matter, tho' what was dipped therein did deſcend, and ſhew a very great cold; ſea-ſalt, mixed with acid ſpirits, heats the liquors, inſtead of cooling them; being mixed with ſpirit of ſalt, it raiſed the liquor of the thermometer ſome lines, without ſhewing any ſenſible fermentation; with oil of vitriol it ferments with a noiſe, and raiſes a great ſmoke; the liquor thickens, and becomes a ſort of clear jelly; the liquor of the thermometer riſes very much in this mixture, and the heat is ſenſible to the touch; all the volatile alkalious ſalts, mix'd with different acid liquors, excited a fermentation more or leſs ſtrong, according to the acidity of the liquors, and the purification of theſe ſalts from their fœtid oils; they all made the liquor of the thermometer fall; but that which did ſo the moſt conſiderably, was the ſalt of urine; an ounce of volatile ſalt of urine, very well rectified in 4 ounces of diſtilled vinegar, made a ſtrong fermentation; the matter was elevated very much, and with a noiſe, and the liquor in the thermometer fell in the fermentation an inch and 9 lines; an ounce of volatile ſalt of urine in 3 ounces of ſpirit of vitriol, raiſed a violent fermentation, during which the liquor of the thermometer fell inches and 4 lines; the mixture of ſalt of tartar, or other fixed alkalious pure ſalts, with acid liquors, excited fermentations with heat; M. *Geoffroy* made all theſe experiments with the ſame thermometer, when the weather was ſufficiently cold, and the temperature of the air equable enough.

As to the reaſon of theſe experiments, M. *Geoffroy* firſt of all examin'd the ſimple cold ſolutions; and having, with all phyſicians, fixed this principle, that cold is nothing, but the diminution of motion, ſo that the coldneſs which the ſalts bring upon the water, ſeems to be occaſioned from this, that the ſalt particles being without motion, and dividing that liquor, diminiſhes it ſo much the more, and this is what produces the cold more or leſs in the ſame liquor: There is one thing to be obſerved; *viz.* that ſome time after the ſolution is made, the liquor of the thermometer riſes again a little, which may be occaſioned by this, that the ſubtile matter which glided abundantly between the liquid particles, had ceaſed to glide there

in

in the ſame quantity for ſome time, the groſs particles of the ſalts intercepting their paſſage; but theſe ſaline particles being divided by little and little, they again open'd the paſſage to the ſubtile matter; this gave the liquor more motion, than it had at the beginning of the ſolution; but yet leſs than it had when it was pure, and without mixture; the ſaline particles, altho' diſſolved, abating ſomewhat of their motion: We may eaſily apprehend, why lixivious ſalts, purely alkalious, and well calcined, as alſo the ſalt of tartar, heat the liquor, and are very far from cooling it, if we conſider that theſe ſalts in the ſtrong calcination, which they have undergone, are impregnated with ſeveral fiery particles, which they impriſon in their pores; theſe igneous particles regain their liberty, by the ſolution of the ſaline particles; and in the ſame time that theſe ſalts ought to ſlacken the motion of the aqueous particles, and cool it, the igneous particles being very active, augment the agitation of the watry particles, till they make it very hot: M. *Geoffroy* obſerves next, that *Sal Armoniac* cools the water wherein it is diſſolved, more than any other ſalt; its cold equals that of water, which is ready to freeze; and it happen'd once, that in diſſolving a good quantity of this ſalt in water, ſome drops which fell on the outſide of the phial, in which he made the ſolution, did freeze, and the ſtraw upon which the phial ſtood, being wet, was faſtened to the glaſs for ſome time by the ice; and this, at a time when the weather was warm; he tried the ſame experiment ſeveral times after, in different ways, but without ever being able to produce ice; chance had apparently made him hit in this experiment, not only on a very exact proportion between the ſalt and the water, but alſo on a temperature in the water beſides, which he ſuppoſes neceſſary; becauſe, the ſolution being quick, the cold muſt alſo be more ſudden and great, and this is that degree of temperature, to which he could never afterwards attain.

The great coldneſs of the ſolution of *Sal Armoniac* does not proceed from any difficulty it has to be diſſolved, ſince it diſſolves ſooner than any other; and ſea-ſalt, whoſe ſolution is difficult, and very ſlow, is that which leaſt cools its diſſolvent: on the contrary, it ſeems that the facility and readineſs, with which it diſſolves, may be the cauſe of this great cold, in this manner; *Sal Armoniac*, as every body knows, is a compoſition of ſea-ſalt, and ſalt of urine; the one very eaſy, and the other very hard to diſſolve; the particles of ſea-ſalt being impriſon'd amongſt the particles of the ſalt of urine, it happens, that

ſeveral

everal of the aqueous particles, at firſt penetrating the ſaline par-
icles of the urine, do there immediately loſe much of their mo-
ion, and this motion grows weaker, by ſo much the more, as the
queous particles meet afterwards with ſaline particles of another
ature, whoſe reſiſtance is much more conſiderable, than that of
he ſalts of urine; ſo in the firſt inſtance of the ſolution, the mo-
ion of a great quantity of aqueous particles being very much
bated all at once, by the ſalts of urine, and by the ſea-ſalt it ex-
ited, in a few moments, a far greater degree of cold than that
f any other ſolutions of ſalts, which water does not penetrate ſo
eadily.

It may be objected, that ſea-ſalt being the hardeſt to diſſolve,
s ſolution ſhould alſo be the coldeſt; to which M. *Geoffroy* an-
wers, that this might be, if the water could penetrate ſuddenly
nto all its parts; but the ſlowneſs, with which it penetrates them,
ecauſe of the cloſe texture of the *Moleculæ* of this ſalt, hinders
hat the diminution of the motion of the parts of the water, can-
ot be ſo ready, nor conſequently ſo great; whereas in *Sal Ar-
oniac*, the parts of the ſea-ſalt being extended by the ſalt of
rine, the pores of the alkalious ſalt of urine are, like ſo many
aſſages, open to the parts of the water, in order to penetrate the
arts of the ſea-ſalt in numberleſs places.

M. *Geoffroy* places in the rank of cold ſolutions, an experiment
ade by M. *Homberg*, which ſerves to prove what M. *Geoffroy*
going to ſay about the cold of *Sal Armoniac*; it is made thus,
ke a pound of corroſive ſublimate, and a pound of *Sal Armo-
iac*, powder them, each a-part, then mix both the powders
ry exactly, put the mixture into a phial, pouring upon it a pint
nd a half of diſtilled vinegar, ſhaking it well together; this
mpoſition will be ſo very cold, that a man can hardly hold the
ſſel in his hands in ſummer; and it happened as M. *Homberg*
as making this mixture, that the ſubject froze; in this expe-
ment we ſee the cold ſtill greater, than that in the ſolution of *Sal
rmoniac* alone in common water; and this cold is cauſed by the
rroſive ſublimate, which alone is not at all, or at leaſt very lit-
e diſſoluble in diſtilled vinegar; ſo that the fluid parts of the
ſtilled vinegar having quickly penetrated the parts of the *Sal
rmoniac*, and having already loſt a great deal of their motion,
terwards engaging in the pores of a body, which they could not
ſſolve, and having no more action than what is ſufficient for that
rpoſe, they loſe there that little activity which they had, and
agulate, if not all, at leaſt the greateſt part; and this want of
tion is the cauſe of that great cold, which we perceive therein.

To ſhew the reaſon of the ſolutions of the ſecond claſs; *viz.* the cold fermentations, M. *Geoffroy* owns, with phyſicians, that heat and cold in liquors are neither more nor leſs than the motion in the little particles of thoſe liquors, cauſed by the continual current of the ſubtile matter in their intermediate ſpaces; and M. *Geoffroy* affirms, that every time this motion is diminiſhed, and the courſe of the ſubtile matter interrupted, the liquor appears leſs hot, or more cold; this being ſuppoſed, if we attend to what happens in cold fermentations, we ſhall obſerve on the one hand for the moſt part, very conſiderable coagulations, and a very ſenſible thickening of the liquors; on the other hand, we ſhall perceive a very violent agitation of ſome of the parts of theſe mixtures; ſeveral vapours are exhaled, the matter ſwells, emits ſeveral bubbles, and ferments with a noiſe; and in this manner M. *Geoffroy* conceives that all theſe effects are produced: In the mixture which he made of ſalts with acid liquors, the greateſt part of the liquor coagulating with a part of the ſalts, its motion was much abated in a little time; but its parts not being able to coagulate, without ſtopping, or weakening the current of the ſubtile matter, this matter finding the paſſages ſhut up, takes its courſe thro' the interſtices, which remain'd between the coagulated particles, where the paſſage is ſtill free, and as it glided in a quantity together, it cauſed a very conſiderable agitation in the parts it met with in its paſſage, which agitation produces the fermentation we perceive, raiſes bubbles of air and ſmoke, and ſwells the matter with ſo much the more violence, as all the parts of the liquor, being almoſt half coagulated, hinder the motion and agitation of theſe little particles; nevertheleſs this agitation, how violent ſoever it may appear, is not conſiderable enough to break the *coagulum* entirely, which is form'd in the liquor, nor conſequently to overcome the cold, which cauſes this coagulation; all it can do, is to preſerve ſtill ſome kind of fluidity: In ſhort, the more theſe mixtures are diſpos'd to coagulate, the more they excite the cold; this we may ſee in the mixture of *Sal Armoniac* with oil of vitriol, in which the *coagulum* becomes ſo ſtrong, that at laſt, it forms over the liquor a very thick ſaline cruſt; in the mixture of other ſalts with weaker acids, as in that of volatile ſalts with ſpirit of vinegar, the *coagulum* can hardly be perceiv'd, nor is the cold ſo conſiderable as in the former; M. *Geoffroy* obſerves farther, that even the violent agitation which this mixture cauſes not being univerſal, and going no farther than ſome few places of the liquor, it may for all that, contribute to the great cold in the mixture of *Sal Armoniac* and oil of vitriol, by increaſing the *coa-*

gula-

rulum, ſo that the little particles, which are violently agitated in this mixture, not being able to carry along with them, in their motion, the coagulated parts, which are too groſs, they drive them away from their center of motion; ſo that the almoſt half coagulated particles, being got amongſt theſe little whirlpools, and preſſed againſt each other, ſtick cloſe together, coagulate more ſtrongly, and loſe their motion entirely, which cauſes a very great cold; and that the violent agitation in ſome parts of the liquor contributes to the coldneſs thereof, appears by the following experiment.

M. *Geoffroy* put ſome cold water into a great baſin, and into the middle thereof a cucurbit of glaſs full of water equally cold, and into the cucurbit he put a very good thermometer, which he let lie a good while for a trial; when it was adjuſted to a degree proportionable to the cold of the water, he ſuddenly threw into the water in the baſin four or five ſhovels full of coals, well kindled, and in an inſtant, the liquor of the thermometer deſcended two or three lines; after ſome moments the liquor roſe again, when the heat of the water in the baſin was communicated to the glaſs cucurbit. The cold of the water in the cucurbit cannot be attributed to any thing, but the preſſure, or ſudden condenſation, which the fire cauſed in the water, wherein it was put; which condenſation may be explain'd in the following manner; in the inſtant that the burning coals were thrown into the water, the vortex of the ſubtile matter, by which it was turn'd round, being preſs'd by the water which environ'd it, ſcatter'd with violence all the particles of the water, which happening all at once in ſeveral places of the water in the baſin all round the glaſs cucurbit, the particles which environ'd the cucurbit being at once preſs'd on all ſides, were condenſed conſiderably and ſucceſſively; the cucurbit being in the center of the preſſure bore all its weight, as well as that of the liquor, which ſurrounded it; and this liquor loſt by its condenſation very much of the motion it had before, which was conſiderable enough to make the liquor of the thermometer fall; this cold goes off quickly, becauſe all the water in the baſin being very much heated, it alſo quickly heats that in the glaſs cucurbit.

The ordinary thermometers not marking the cold of the water ſo readily and nicely, as M. *Geoffroy* could have wiſhed, he had recourſe to another ſort of thermometer, which was more exact; it conſiſts of a bowl of glaſs, Plate II. Fig. 18. which has no other aperture than that of a very long tunnel B C, which deſcends almoſt to the bottom of the bowl; one end of the tunnel B

is dipp'd in E, a liquor which is at the bottom of this bowl, and the reſt is fill'd with nothing but air, which has no communication with the external air; when the air contain'd in this ſpace is rarified by the external air, which touches the bottle, it preſſes at the ſame time the liquor E, and obliges it to riſe by B in the tunnel B C; on the contrary, when it is condenſed by the external cold, by not preſſing upon the liquor E, it gives liberty to that which is in the tunnel to fall: The readineſs with which the air condenſes, or rarifies by cold and heat, makes the effects of this thermometer, much more ſudden than thoſe of any other ſort; beſides, the effects of this is much greater, the air being capable of a greater rarefaction, or greater condenſation than any other fluid.

As for the ſenſible heat of the vapours, which are exhaled from the mixture of *Sal Armoniac* with oil of vitriol, it is not difficult to find the cauſe, if we conſider that theſe vapours are but the moſt volatile and active parts of this mixture, which the ſubtile matter raiſes with itſelf in pervading it; the motion of theſe particles is free in the air, and is but more repreſs'd by the too groſs coagulated particles in the liquor; and by how much it has been retain'd and hinder'd for ſome time, it becomes ſo much the more violent, and is perceiv'd by heat, which is the ordinary effect of a rapid and violent motion.

If after having made a mixture of four ounces of oil of vitriol and an ounce of *Sal Armoniac*, you throw upon it a ſpoonful of common water, in the time when the fermentation is ſtrongeſt, the cold is greateſt, and the liquor of the thermometer falls with the greateſt quickneſs; the fermentation ceaſes, and the cold changes immediately into a great heat, which makes the liquor of the thermometer to riſe very high; the reaſon of this experiment may be eaſily conceiv'd, if we conſider, that the water being heated quickly and ſtrongly by the oil of vitriol, produces here the ſame effect; and this heat is ſufficiently great at that time to deſtroy the cold of the coagulated particles, the water by itſelf being otherwiſe very proper to diſſolve this *coagulum*.

An unuſual Colic, *by Dr.* Davies. Phil. Tranſ. N° 275. p. 963.

A Perſon, aged between 50 and 60, had been for three or four years troubled with gripes, which generally return'd once a month, or thereabouts; his body being for the moſt part coſtive he therefore, was obliged to ſpur nature with *Daffey's* elixir, or aloes, and ſometimes the ſmoaking a pipe of tobacco ſupplied the uſe of theſe medicines; coming from *London* he over-

heated

ted himſelf with his journey, having walk'd a good part of way; and as ſoon as he came home, he had a return of his ic pains, which continued upon him for 18 days, notwithſtand- the methods commonly uſed in ſuch caſes, during which time had no ſtool, excepting what the firſt and ſecond clyſters ught away; he complained when he was ſeiſed with this diſ- er of a pain in his right ſide, in the *Iliac* region; ſome time ore he died, his belly ſwelled much, and was as tenſe as a m; at firſt he vomited for two or three days, which left him, did not return till juſt before he died, which was at the ex- ation of the 18th day, at which time he brought up ſome ck choler, but never, during his whole illneſs, any of the *ces*: Upon opening the *Abdomen*, ſome black choler was nd in the ſtomach; the *Duodenum* and the reſt of the *Inte- a Tenuia* were void of *Fæces*, but very much inflated with nd; and tracing the guts, as far as the *Cœcum*, it was found of lackiſh colour; and from thence, for about a yard in length, *Colon* was ſo mortified, that the *Fæces* had made their way o' it in ſeveral places into the cavity of the *Abdomen*; about inches of the mortified gut was faſtened to the *Peritonæum* the right ſide; this part of the *Colon* was extended with a at quantity of *Fæces* of a ſoft conſiſtence; at the extremity of mortification, towards the *Rectum*, the obſtruction which uſed all theſe diſorders, offer'd itſelf to view very plainly; for ut 10 inches of the *Colon* was doubled, as if you had taken folded up a piece of tape; the two contiguous ſurfaces of the licature adhered ſo firmly together, that you could not ſepa- them, without tearing the external coat of the inteſtine; n ſeparating this coaleſcence, there fell from that part a itiſh *Mucus*; the adheſion was about three inches broad; the ddle of the duplicature, which made an acute angle, and ere the *Fæces* ſtopp'd, was ſmaller, and the membranes thin- , than in any other part of the gut; from thence towards the *ctum*, the *Colon* was ſound, and void of *Fæces*, occaſioned by frequent uſe of clyſters.

e Iſthmus *between* Dover *and* Calais; *by Dr.* Wallis. Phil. Tranſ. N° 275. p. 967.

MR. *Somner* N° 272. p. 882. is of opinion (with Mr. *Cambden*, and other Antiquaries) that it is highly probable, if abſolutely certain that *France* and *England*, or *Gaul* and *itany* were anciently joined by an *Iſthmus*, or neck of land, ere now is the narrow paſſage between *Dover* and *Calais*; which

which ſeveral ages ago (beyond the reach of any hiſtory now extant) was, by the violent beating of the ſea on both ſides thereof, worn away, or broken thro'; whereby, what was once an *Iſthmus*, is now become a *Fretum* or narrow ſea; in ſupport of the ſame opinion Dr. *Wallis* adds one argument more, (of which M. *Camden* takes no notice) *viz.* the ancient *Gauls*, and *Britons* uſing the ſame language, and the great intercourſe between the *Druides* in *Gaul*, and thoſe in *Britany* (of which ancient authors take notice) which is not likely to be the caſe, if there had not been an eaſy communication between the one, and the other; which, tho' it be not a phyſical argument (as thoſe of Mr. *Camden* are) is a good moral inducement, in confirmation of them.

To inforce Mr. *Somner*'s arguments, Dr. *Wallis* conſiders, what muſt have happened, if this hypotheſis be true, and how it agrees with what we ſee. 1. If there was ſuch an *Iſthmus* once, in that place where now is the *Paſs* between *Dover*, and *Calais*, then the great ſeas on both ſides muſt continually beat upon it, with a fierce impetuous tide, twice in 24 hours; *viz.* the northern ſea between us, and *Holland*, called the *German Ocean*, on the eaſtern ſide; and the weſtern ſea, between us, and *France*, called the *Britiſh Ocean*, on the weſtern ſide, which, in proceſs of time, may well be ſuppoſed likely enough to wear away, or break thro' a narrow *Iſthmus*; the weſtern tide coming in fiercely between us and *France*, and fretting on the coaſt on both ſides, muſt needs be ſuppoſed to bring with it, not only a great deal of ſoil, ſand, or mud, but being ſtopp'd in its current, by this *Iſthmus*, did not depoſite it (as might be thought) on its ſide, which might ſtrengthen it, but found an opportunity of diſcharging itſelf on the ſpacious level of *Romney-marſh*, fretting that *Iſthmus* as it came along, and then, at the time of the tide's receſs, letting it fall on that level, and lodging it there; but then again, fretting that *Iſthmus*, and the coaſt all along, as the tide returned with a like force, as it came in; which gives us a fair account, both how that *Iſthmus* might be waſhed away, and how that level might be raiſed to the height it is now at; for, no man can doubt (who well knows the ſituation of the place, and the nature of the ſoil) but that all that level had heretofore been ſea; and even, at this day, it lies ſo much lower, than the ſurface of the ſea at high-water; that much of it would be overflowed every tide, if not defended by *Dim-church Wall*, for ſeveral miles together, whether it had the like opportunity of ſuch an in-draught, and in what proportion on the *French* coaſt, the Dr. cannot tell.

The

The northern-ſea, between us and *Holland*, muſt in like manner, have beat on the eaſt-ſide of that *Iſthmus*, with a like impetuous tide, twice in 24 hours; but, being ſtopped there in its courſe, would have the like opportunity of diſcharging itſelf on the coaſt of *Holland*, as the weſtern-ſea did on *Romney-marſh*; whence it is that *Holland*, and *Zealand*, which, by the conſent of all, is judged to have been once ſea, is now raiſed 30 or 40 foot higher, than it had been formerly; and the ſame northern ſea, which, upon this account, hath ſo large an in-let, eaſtwards, on the coaſt of *Holland*, would, weſtwards, inſinuate itſelf likewiſe on the *Engliſh* coaſt, wherever it might find low grounds; which is the caſe of this large valley, where now runs the river *Sture*, *Stoure*, or *Eſture* (which name it is ſuppoſed to have taken from the corruption of *Æſtuarium*) for more than 20 miles, entering at the low grounds near *Sandwich*, cloſe by that *Iſthmus*, and running up that level by *Canterbury*, *Chartham*, *Chilham*, &c. as far as *Aſhford*, or farther; which valley had once been much deeper, than it is now; for, it ſeems, that even at *Chartham*, which is now 12 miles from the ſea, the ground is raiſed at leaſt 17 foot; and the ſoil at that depth is found to be of a like condition, with that, where the ſea is known to have been; and nearer to the ſea, it may well be preſumed to have been ſtill deeper; which is confirmed, as Mr. *Somner* tells us, by the reliques of a marine animal found there, as alſo anchors, ſhells of fiſh, dug elſewhere in the borders of this valley, at a great depth under ground: Now, that the ſea may thus raiſe the ground on ſuch in-draughts, by ſand, ſoil, and mud, conveyed and lodged there at every tide, is not at all unlikely; for, we ſee the ſame at this day, particularly, in the iſle of *Oxney*, near *Romney-marſh*, where was a low level, often in danger of being overflowed by the river *Rother*; but, ſomewhat more than threeſcore years ago, the ſea being let in, hath raiſed that level very conſiderably, by bringing in, and lodging there, a conſiderable deal of ſoil and mud every tide; but withal, it has ſo fretted the channel by which it enters and returns again, that the channel by *Rye*, which, within the Doctor's memory, was ſo ſhallow near (what was called) *Kent-bridge*, that it was fordable; but now, by the tides entering, and returning, that bridge is long ſince ſwallowed up, and the channel become ſo broad, and deep, that a veſſel of good burden might ride there at anchor, which is a proper reſemblance of the ſeas fretting this *Iſthmus*, and filling up the *Æſtuaries* on both ſides thereof: The like, in a good meaſure, is to be ſeen at the *Dogger-ſands*, which is a bank

bank of ſand lying obliquely, from about the coaſt of *Norfolk* towards the coaſt of *Zealand*, or north part of *Holland*; which is the place, where the northern, and weſtern tides, ſince the rupture of the *Iſthmus*, do now meet, and there (at ſlack-water, for about an hour, or at the turning of the tide) depoſite the mud, and ſand, which, by their rapid motion, is brought thither both ways, and which is ſuppoſed to be the true cauſe of that ſand-bank; whether this, in proceſs of time, may form a new *Iſthmus* there, (if the world laſt long enough) the Dr. cannot ſay; but, he is apt to think, that the former *Iſthmus*, if the tides had ſtopped there, and had not found thoſe in-draughts whereon to lodge what is waſhed from thence, might have continued, and been more ſtrengthened, by what, on the return of the tide, would daily be lodged there: And upon this account it is, the Dr. thinks, that the *Iſthmus* at *Corinth*, tho' beat upon by the two ſeas, which give it the name of *Bimaris Corinthus*, is not thereby deſtroyed, becauſe, there are not ſuch tides to waſh it away, nor ſuch in-draughts, whereon to lodge what might be waſhed from thence; but the caſe is much otherwiſe with this *Iſthmus* of ours, where all circumſtances concur to countenance this hypotheſis; the ſteep cliffs at *Dover*, and thoſe at *Calais*, anſwering directly the one to the other, and appearing to view, as if, what had been between them, had been violently torn away, as alſo the intermediate ſea, even at this day, being much ſhallower at that place, than on either ſide of it (as *Cambden* well obſerves) are ſtrong preſumptions, that there had been formerly ſuch a conjunction.

The greateſt doubt in this caſe is, that there is no hiſtory extant, which takes notice of ſuch an *Iſthmus*, or of ſuch a rupture in this place; to remove this, we are to conſider that we have no particular account of the *Britiſh* coaſt (which might determine this queſtion) older than *Julius Cæſar*; whereas, this might have happened ſeveral hundreds of years before that time, when, tho' the iſland itſelf might be known to the *Greeks* and *Romans*, yet not its particular coaſtings: But the Dr. adds further, that *Plato* tells us a ſtory (as of a thing which had happened ſome ages before his time, and which then, was in a manner generally forgotten) of an iſland ſomewhere in the *Atlantic Ocean*, which by a deluge, and earthquake, in the ſpace of a night and day, was deſtroyed and ſwallowed up by the ſea, whereby, that ſea, formerly navigable, was for ſome time become dangerous; by reaſon of the mud, and reliques of that abſorbed iſland; which ſeems to the Dr. very applicable to the rupture of this *Iſthmus*, whereby,

whereby this iſland was not, indeed, entirely deſtroy'd, but was broken off from the continent, to which it was before united; and, upon ſuch an accident, the ſea muſt needs be diſturbed, put out of its courſe, and rendered unſafe for paſſage, before it came to be ſettled again; for, tho' the firſt breach might be made in the ſpace of one night and day, we cannot ſuppoſe the whole bulk of it, when once broken, to be preſently carried quite away; but firſt the top, or upper part of it, in a day and night's time, and afterwards the lower parts thereof by degrees; which would render that ſea, if not quite unpaſſable, yet dangerous at leaſt; and, if in ſome circumſtance, this narration happens to differ from the matter of fact; as calling the rupture of this *Iſthmus*, the ſubverſion of an iſland; this muſt be allowed in the narrative of an old tradition from hand to hand, for, as ſuch, it is there brought in: *Plato* introduces *Critias*, then an old man, telling a ſtory, which, when he was a boy of 10 years old, he had heard from his grandfather, who was 90 years of age, what *Solon*, long ſince dead, had told him; namely, that an *Egyptian* prieſt had, long before, told *Solon*, that it appeared from ſome old *Egyptian* records, of which the *Greeks* had no knowledge, that ſuch a thing had happen'd, in an age ſo long before, that, in compariſon, the *Greeks* were but as children; and all this tradition, thro' ſo many hands, and at ſuch great intervals of time, is, at every ſtep, reported from the relator's preſent memory; and it is very poſſible, that ſome one or other of theſe relators might ſo far miſtake, or miſremember, as to call that a diſſolution or diſappearance of an iſland, which was but a tearing of it from the continent: It ſerves, however, to the preſent purpoſe, if at leaſt ſo much of the ſtory be true, that long before *Plato*'s time, there had been ſome ſuch diſſolution, or rupture of an iſle or *Iſthmus*, ſomewhere in the *Atlantic* ocean, that is, in the northern ſea, of which there were ſome ſymptoms yet remaining in *Plato*'s time; for, this being admitted, it is as applicable to the preſent caſe, as to any we know, of which there are ſo many ſymptoms yet remaining to this day; and tho' *Olaus Rudbec* in his *Atlantica*, *cap.* 7, *ſect.* 8, *p.* 293, endeavours, in favour of his *Sueonia*, to put an allegorical ſenſe upon all this paſſage; yet Dr. *Wallis* does not ſee, why, it may not be underſtood in a plain literal ſenſe, as a true matter of fact, tho' perhaps a little diſguiſed, as was the manner of that age, in relating old ſtories, and is very conſiſtent with all that *Rudbec* cites out of *Plato*, in the ſaid chapter of his *Atlantica*; for, the name of the *Atlantic* ſea, wherein this iſland is ſaid to be, was not then,

nor is it now, confined to the coaſt of *Sweden*, but extended as far as the *Britiſh* iſland, and much farther; and when *Rudbec* tells us out of *Plato*, *that the whole* Atlantica *was as big as* Lybia *and* Aſia, which whether meant of either of them ſingly, as *Rudbec* underſtands it, or of both together, as the words ſeem to import, the Dr. will not contend: We cannot ſuppoſe it to be *Plato*'s meaning, that this whole region was ſwallowed up, but rather ſome ſmall part thereof, from whence, perhaps, the whole might take its denomination; and tho' he tells us from another author, that it was five days voyage from the *Britiſh* iſland, to that part of his *Atlantica*, where for 30 days together the ſun does not ſet, this does not hinder, but that the *Britiſh* iſlands may be part of the *Atlantic* region, tho' ſo far diſtant from the utmoſt northern cape thereof.

Mr. *Somner* tells us, that this *Æſtuary* from *Sandwich* to *Aſhford*, might perhaps flow ſo much farther, as to meet with that *Æſtuary* on *Romney-marſh*, and both being joined together, become one level; there is, the Dr. thinks, three or four miles diſtance, between *Aſhford*, and the neareſt part of *Romney-marſh*; and, if it be admitted, that the two *Æſtuaries* of *Stoure* and *Romney-marſh*, did thus meet in former times, this opens a new ſcheme, of which before we were not aware; for, then we muſt ſay, that the two tides from the north and weſt, which now meet at the *Dogger-ſands*, did then meet at the confluence of theſe two *Æſtuaries*; and then, as was juſt now ſaid of the *Dogger-ſands*, bringing on both ſides, ſoil, mud, and ſand to this place, and lodging it there, might firſt form an *Iſthmus* between *Dover* and *Calais*, and open a new paſſage, ſuch as it is now; there are ſeveral other *Æſtuaries* in *England*, where the ſea enters a great way into the land, and how far it might have enter'd in former times cannot be determined; as that ſea by *Briſtol*, between *Wales* and *Cornwal*; that of the *Humber*, between *Yorkſhire* and *Lincolnſhire*; and we may reaſonably ſuppoſe, that the waſhes and fenns in *Lincolnſhire*, might heretofore have been ſea, or overflow'd by the ſea at high tides; and that of the *Thames* between *Kent* and *Eſſex*, which now flows above *London* and *Brentford*, within a mile of *Kingſton* at ſpring-tides; it may perhaps ſeem too daring, to think that it formerly flow'd as far as *Oxford*, between *Shot-over-hill* and *Foxcomb-hill*, and ſo on towards *Wallingford*, in the time of the *Romans* called *Galena*; but there is this to countenance it, that there are frequently found, in our ſtone-quarries and gravel-pits about *Oxford*, fiſh-ſhells, and even the bodies of fiſh petrified, at great depths under

under ground; and there have been, no doubt, and there now are in *England* ſeveral other *Æſtuaries*, creeks, or arms of the ſea, entering a great way within the land, ſome whereof may, in a manner, be filled up, and become firm land; others, much narrower, ſhallower, and ſhorter, than they have been in former times; for, it is the nature of *Æſtuaries*, where the tides flow in, to leave behind them, at their return, a deal of mud, ouſe, or ſleech, as they call it, which in time becomes firm land.

At *Hythe* in *Kent*, which is one of the *Cinque Ports*, there was formerly a convenient harbour for ſmall veſſels, which is now ſwarv'd up; ſeveral attempts have been made to recover the harbour, but with little ſucceſs; for, when, with great labour and charge, they have in ſome meaſure open'd it, it has ſoon been filled up again, by what the ſea caſts up; and, whoever conſiders the vaſt quantity of, what they call, beach, that is, ſmall looſe ſtones and fiſh-ſhells, caſt up by the ſea, at *Hythe*, *Lyd*, and elſewhere on the coaſt of *Romney-marſh*, for ſeveral miles in length and breadth, and to a great depth, will not think it ſtrange, that a creek, or *Æſtuary*, ſhould in time come to be filled up, and become firm land; and in ſeveral places, this beachy ground, where, nothing was to be ſeen, but ſuch looſe ſtones and ſhells to a great depth, comes, by degrees, to be cover'd with earth, and becomes paſture-ground: On the contrary, that what was formerly firm land, might be ſo deſtroy'd, or waſh'd away, as to become ſea, is evident from the *Goodwin-ſands*, on the coaſt of *Kent*, which are ſaid to have been the lands of Earl *Goodwin*, but loſt by inundation, about the time that *Tenderden* ſteeple was built (which gave occaſion to that ironical proverb of things co-temporary, that *Tenderden-ſteeple was the cauſe of Goodwin-ſands*) the occaſion of ſuch different effects, depending on the different ſituation of the ſhores, and the ſetting of the tides, ſo as to waſh off from one place, what it lodges on another: And many ſuch alterations have, no doubt, happen'd on the face of the earth all the world over, of which we have no particular hiſtories; for, the world was of a great age, before the writing of any hiſtory, except the bible; and who knows, but, that in former ages, there might have been, even amidſt the *Alps*, large lakes, which, in proceſs of time, by earthquakes, or other accidents, might have been drain'd of their water, and become fruitful valleys; of which, it is ſaid, divers ſymptoms have been diſcover'd, even amidſt the *Alps*, in later ages; and ſomething of the like nature has happen'd in *Jamaica*, *Sicily*, and other places.

Trees *found under Ground in* Hatfield-chace; *by Mr.* Abraham de la Pryme. Phil. Tranſ. N° 275. p. 980.

THE levels of *Hatfield-chace* in *Yorkſhire*, were the largeſt chace of red deer that King *Charles* I. had in all *England*, containing in all above 180000 acres of land, about half of which was yearly drown'd with vaſt quantities of water; which being ſold to one Sir *Cornelius Vermuiden*, a *Dutchman*, he at length effectually diſchaced, drained, and reduced it, both to arable and paſture lands, at the expence of above 400000*l.* In the ſoil of all, or greateſt part of the ſaid 180000 acres of land, whereof 90000 were drained, even in the bottom of the river *Ouſe*, and of the adventitious ſoil of all *Marſhland*, and round about by the ſkirts of the *Lincolnſhire* woulds, as far as *Gainsborough*, *Bantry*, *Doncaſter*, *Baln*, *Snaith*, and *Holden*, are found vaſt numbers of the roots and trunks of trees of all ſizes, great and ſmall; and of moſt ſpecies that this iſland either formerly did, or at preſent does produce; as pitch-trees, commonly call'd firs, oaks, birch, beech, yew, wirethorn, willow, aſh, &c. the roots of all, or moſt of which ſtand in the ſoil in their natural poſition, as thick as ever they could grow, and the trunks of moſt of them lie by their proper roots; moſt of the large trees lie along about a yard from their roots (to which they belong'd, as appears very plainly both by their ſituation, and the ſameneſs of the wood) with their tops commonly north-eaſt; tho', indeed, the ſmaller trees lie almoſt every way, a-croſs the former, ſome over, and others under them; the third part of all, which are pitch-trees, commonly call'd firrs, are ſome of them 30 yards long and upwards, and ſold for maſts and keels of ſhips; there have been oaks found 20, 30, 35 yards long, yet wanting ſeveral yards at the ſmall end; ſome of which have been ſold at 4, 8, 10, and 15*l.* a piece, which are as black as ebony, and very durable in any ſervice they are put to; as for aſh, it is commonly obſerved, that the conſtituent parts of their texture are ſo diſſolved, that they are become as ſoft as earth, and are commonly cut in pieces by the workmen's ſpades, which, as ſoon as they are flung up into the open air, crumble into duſt; but all the reſt, even the willows themſelves, which are ſofter than aſh, preſerve their ſubſtance and texture entire to this day; Mr. *de la Pryme* has ſeen pitch, or firr-trees, that as they lay along, after they had fallen, emitted large branches from their ſides, which had grown up to the bulk and height of conſiderable trees.

It is very obſervable, and manifeſtly evident, that ſeveral of all thoſe ſorts of trees have been burnt; but eſpecially, the pitch or firr-trees; ſome quite thro', and others all on one ſide; ſome have been found chopp'd and ſquar'd, others bored thro', and others half ſplit with large wooden wedges, with ſtones therein, and broken ax-heads, ſomewhat reſembling the figure of ſacrificing-axes; and all this in ſuch places, and at ſuch depths, as could not be open'd, ſince the deſtruction of this foreſt, till the time of the drainage; near a large root, in the pariſh of *Hatfield*, were found eight or nine coins of ſome of the *Roman* Emperors, very much conſumed and defaced; and it is very obſervable, that upon the confines of this low country between *Burningham* and *Brumby* in *Lincolnſhire*, are ſeveral large hills of looſe ſand, under which, as they are yearly worn and blown away, are diſcovered ſeveral roots of large firrs, with the marks of the ax as freſh upon them, as if they had been cut down but a few weeks, and this Mr. *de la Pryme* has often ſeen; hazle-nuts and acorns have been frequently found at the bottom of the ſoil of thoſe levels and moors, and whole buſhels of firr-tree apples, or cones, in large quantities together; and at the very bottom of a new river, or drain, almoſt 100 yards wide, and four or five miles long, were found old trees ſquar'd and cut, rails, ſtoups, bars, old links of chains, horſe-heads, an old ax, ſomewhat like a battle-ax; two or three coins of the Emperor *Veſpaſian*, one of which Mr. *de la Pryme* ſaw with Mr. *Cornelius Lee* of *Hatfield*, having the Emperor's head upon one ſide, and on the reverſe a ſpread eagle; but that which is more obſervable, is, that the very ground, at the bottom of the drain, was found in ſome places to lie in ridges and furrows, thereby plainly ſhewing that it had been plow'd and till'd in former days.

Mr. *Edw. Canby* told Mr. *de la Pryme*, that there was found under a large tree, in the pariſh of *Hatfield*, an old faſhioned knife, with a haft of a very hard and black ſort of wood, which had a cap of copper or braſs on the one end, and a ring of the ſame metal on the other end, where the blade went in, which blade ſoon mouldering away, he got a new one put in the haft, with the following diſtich thereon,

Ever ſince No's *flood was I left,*
My old blade is conſumed, but this is the haft.

The ſame gentleman alſo found an oak-tree within his moors, 60 yards long, 4 yards diameter at the great end, 3 yards and a foot

foot in the middle, and 2 yards at the ſmaller end; ſo that, by a moderate computation, the tree ſeem'd to be twice as long; and for it he was profer'd 20*l.* At another time, he found a firr-tree 36 yards long, beſides the computed length thereof, which might well be 15 yards more, ſo that there have been exceeding large trees in theſe levels; and what is alſo very ſtrange, is, that there was found, at the very bottom of a turf-pit, a man lying along, with his head upon his arm, as in a common poſture of ſleep, whoſe ſkin being tann'd, as it were, by the moor water, preſerv'd his ſhape entirely, but his fleſh, and moſt of his bones were conſumed.

To illuſtrate and render more intelligible this ſtrange ſubject of ſubterraneous trees, let us ſee what has been obſerved in other places and countries; *Cambden*, and others, have told us, and it is a very common and well-known thing, that moſt of the great moraſſes, moſſes, fens, and bogs in *Somerſetſhire*, *Cheſhire*, *Lancaſhire*, *Weſtmoreland*, *Yorkſhire*, *Staffordſhire*, *Lincolnſhire*, and other counties in *England*, are full of the roots and trunks of large trees, moſt of which are pitch or firr; and that they have the ſame poſitions and impreſſions of the fire and ax upon them, that thoſe, already mentioned, have: *Giraldus Cambrenſis* tells us, that in King *Henry* II's days, by the violence of exceſſive ſtorms, the ſands were ſo much driven off the ſea-ſhore in *Pembrokeſhire*, that under them were diſcovered great numbers of roots and trunks of trees in their natural poſitions, with the impreſſions of the ax, as freſh upon them, as if they had been cut down but yeſterday, with a very black ſoil, and ſome blocks like ebony; and the like were diſcovered alſo at *Neugal* in the ſame county, in 1590, and in *Cardiganſhire* and other places ſince; Dr. *Plott* mentions the like roots and trees, found in *Shebbenpool*, the old *Pewit-pool*, and at *Layton*, and other places in *Staffordſhire*; and from their natural ſituations he rightly concludes, that they certainly grew there: Dr. *Leigh*, in his hiſtory of *Cheſhire*, obſerves, that in draining *Martin Meer*, there was found great numbers of the roots and trunks of large pitch-trees, in their natural poſitions, with great quantities of their cones, and eight canoes, ſuch as the old *Britons* ſail'd in; and in another moor, was found a braſs-kettle, beads of amber, a ſmall mill-ſtone, the head of an *Hippopotamus*, and human bodies entire and uncorrupted, as to outward appearance: Several places of the ſoil of the iſles of *Angleſea* and *Man*, as alſo of the boggs of *Ireland*, are likewiſe full of roots and trees; *Verſtegan* tells us, that in ſeveral places of the moors and moraſſes of the *Netherlands*,

therlands, large firr-trees are commonly found, with their tops lying to the north-eaſt, juſt as they do in the levels of *Hatfield-chace*; and *Helmont* mentions the *Peel* there, a moſs nine miles broad; M. *de la Ferr* ſays, that trees and roots are frequently found in the low grounds, levels, and moraſſes of *France*, *Switzerland*, and *Savoy*; and laſtly, *Rammazzini* aſſures us, that in the territories of *Modena*, which are ſeveral miles long and broad, and at preſent a moſt fruitful dry country, tho' in the time of the *Cæſars*, it was nothing but a great lake, are found at 30, 40, and 50 foot deep, the ſoil of a low marſhy country, full of ſedge, reeds, ſhrubs, roots, trees, nuts, ears of corn, leaves of trees, branches and boughs of oaks, elms, walnuts, aſhes, willows, and the very trees themſelves, ſome broken, ſome whole, ſome ſtanding upright, ſome lying at their length, *&c.* with old coins of the *Roman* Emperors, old marbles and ſtones ſquared, cut, carved, and wrought, *&c.* Moſt men refer all this to *Noah*'s flood; but if ſo, how comes it, that the trees and their roots lie ſo near each other, and why lengthwiſe, from ſouth-weſt to north-eaſt? Why ſome of them burnt, others chopped, ſome ſplit, others ſquared, and others bored thro'? Why does the ſoil at the very bottom of a large river lie in ridges and furrows? And why are the coins of *Roman* Emperors found there? But Mr. *de la Pryme* is of opinion, that all theſe trees grew in the very places, where we now find them, both here, and elſewhere; againſt which M. *de la Pryme* knows but of two objections. 1. That *Cæſar* expreſly ſays, that no firr-trees grew in his time in *Britain*; but that *Cæſar* might have been miſtaken in this point, may appear from what he mentions of the next tree, the beech; which he alſo excludes, tho' it is ſo very common in every part of this kingdom; and, in an old deed relating to this very chace, firr-trees or buſhes are mention'd, as growing here and there, about 300 years ago; and it is very well known, that there was a tree of the very ſame wood growing upon *Hatfield-moor* ſide within theſe 30 years, which was cut down ſome time after, it being the very laſt of that kind, that was ſeen flouriſhing here. 2. The ſecond objection is, that thoſe ſorts of trees grow always on high mountains and rocks, and never thrive upon ſuch low grounds and moraſſes as theſe are, where we now find them; but, tho' they do, indeed, in all the cold countries of the north, thrive beſt upon the hardeſt rocks and mountains, yet are they ſometimes ſeen even there, large and in great plenty, in the low moraſſes of *Liefland*, *Courland*, *Pomerania*, and other countries thereabouts; and in the low forreſts

to

to the weſtward of *New England*; theſe trees require a ſandy ſoil, and if it lie never ſo high, or never ſo low, they will grow there, and there it is natural for them; and it was obſerved, in digging a pit of a great decoy in theſe levels, that the roots of the firrs always ſtood in the ſand, and the oaks in the clay, as alſo in ſeveral other places of theſe commons.

The reaſon why all theſe woods were deſtroy'd, we may learn from the *Roman* hiſtorians, who frequently tells us, that when their armies and generals purſued the wild *Britons*, they always fled into the faſtneſſes of miry woods and low watry foreſts; *Cæſar* himſelf tells the ſame, and ſays, that *Caſſibelan*, and his *Britons*, after their defeat, paſſed the *Thames*; and fled into ſuch low moraſſes and woods, that there was no poſſibility of following them; we alſo find, that the ſtout nation of the *Silures* did the ſame, when they were ſet upon by *Oſtorius* and *Agricola*; and ſo did *Venutius*, King of the *Brigantes*, who fled into the great woody moraſſes of this country, and, perhaps, into the very ſame that formerly overſpread theſe levels; and *Herodian* tells us, that it was the cuſtom of the wild *Britons* to keep in the fenny bogs and thick marſhy woods, and when opportunity offer'd, to ſally out, and fall upon the *Romans*; who were at length ſo gall'd with them, that they were forc'd to iſſue out orders for the deſtroying and cutting down all the woods and foreſts in *Britain*; eſpecially all thoſe that grew upon low grounds and moraſſes; this order is mention'd in *Vopiſcus*; and that they were thereupon accordingly cut down, is evident from ſeveral authors, who tell us, that when *Suetonius Paulinus* conquer'd *Angleſea*, he cut down all the woods there; *Galen* tells us, that the *Romans* kept their ſoldiers continually employ'd in cutting down woods, draining marſhes and fens, and paving bogs; it is alſo manifeſt, that they did not only do this themſelves, but alſo impos'd the ſame taſk upon the *Britons*; for, *Galgacus*, in his ſpeech to his ſoldiers, tells them, that the *Romans* made ſlaves of them, and wore out their bodies in cutting down woods, and cleanſing bogs, amidſt a thouſand ſtripes and indignities; and *Dion Caſſius* tells us, that the Emperor *Severus* loſt 50000 of his men in a few years time, in cutting down the woods, and cleanſing the fens and moraſſes of the country.

As Mr. *de la Pryme* has ſhewn in general, that the *Romans* deſtroy'd thoſe great woods and foreſts; ſo now he comes to ſhew in particular, that they actually were in this part of the country, and deſtroyed this large and beautiful foreſt of

Hat-

Hatfield-chace; the common road of the *Romans* out of the ſouth, into the north parts of the country, was formerly from *Lindum* or *Lincoln*, to *Segelocum*, or *Little Burrow* upon *Trent*, and from thence to *Danum* or *Doncaſter*, where they kept a ſtanding garriſon of *Criſpinian* horſe; a little off to the eaſt and north-eaſt of this road, between the two laſt nam'd towns, lay the borders of the large foreſt, which ſwarm'd with wild *Britons*, who were continually ſallying out, and retreating into it again, intercepting the *Romans* proviſions, taking and deſtroying their carriages, killing their allies and paſſengers, and diſturbing their garriſons, which at length ſo enraged the *Romans*, that they were reſolved to deſtroy it; and that they might do it the more effectually, they marched with a great army, and encamp'd upon a ſpacious heath, or moor, not far from *Finningly* (as appears by their fortifications ſtill to be ſeen there) where it is probable that a great battle enſued, for hard by, is a little town, called *Oſterfield*; now, as the latter part of the word is never added to any other, but where there has been a battle fought, ſo, the former ſeems to inform us what *Roman* general it was, who commanded; to wit, the famous *Oſtorius*, who, all the *Roman* hiſtorians aſſure us, had been in thoſe parts; but who got the victory is not ſo eaſy to be judged, tho' no doubt it was the valiant *Romans*, who, beſides the great numbers of *Britons* they ſlew, drove the reſt back into the great foreſt and wood, that covered all this low country; whereupon, the *Romans*, that they might deſtroy both it and the enemy the eaſier, took the opportunity of a ſtrong ſouth-weſt wind, and ſet large fires therein, which taking hold of the firr-trees, burnt like pitch, and conſumed vaſt numbers of them; then, when the firr had done what miſchief and execution it could, the *Romans* drew their army nearer, and with whole legions of captive *Britons* felled moſt of the trees that were ſtill ſtanding, leaving only here and there ſome large ones untouch'd, as monuments of their fury; which being deſtitute of the ſupport of the under-wood, and of the neighbouring trees, were eaſily overthrown by the ſtrong wind; all which trees falling croſs the rivers, that formerly ran thro' this low country, ſoon damm'd up the ſame, turned it into a great lake, and gave origin to the great turf-moors that are here, by the windings and workings of the waters, the precipitation of terreſtrial matter therefrom, the conſumption and putrefaction of rotten boughs and branches, and the vaſt increaſe of thick moſs-water, which wonderfully flouriſhes, and grows upon ſuch rotten grounds; which, even now ſince the drainage, and ſince the country for ſeveral miles round has been laid dry, yet for all

that, are ſo turgid with water, and ſo ſoft and rotten, that they will ſcarcely bear men to walk upon them; hence it is, that old *Roman* coins, old *Roman* ax-heads, &c. have been found by thoſe roots and trees, that lie at the bottom of theſe moors and levels; hence it is, that in all theſe grounds are found great numbers of trees, that are burnt ſome in two, and others lengthwiſe, and ſome hew'd and chopp'd; hence it is, that they lie by their own proper roots, with their tops north-eaſt; hence it is, that they lie by their own proper roots, with their tops north-eaſt; hence it is, that ſome of the largeſt trees are found with their roots on, and others, as they have laid all along, have had branches growing out of their ſides, to the bulk and height of conſiderable trees; hence it is, that both the clay and moor-ſoil of the country is in ſome places two or three yards higher, than it was formerly by the growing up of the ſame, and the daily warp that the rivers caſt continually thereon, &c.

As the *Romans* were the deſtroyers of this great foreſt, ſo were they likewiſe of all thoſe others, that formerly grew upon the low-lands of *Cheſhire*, *Lancaſhire*, *Yorkſhire*, *Lincolnſhire*, *Staffordſhire*, *Somerſetſhire*, &c. and of the countries before-mentioned beyond ſea, where ſuch trees are found; but, as the *Romans* were not much in *Wales*, the *Iſle of Man*, or *Ireland*, ſo it cannot be ſuppoſed that they cut down their woods; but, yet others did, for *Holling ſhead*, and others of our hiſtorians, tell us, that *Edward* I. not being able to get near the *Welch* to fight them, by their ſtaying and ſkulking in the boggy woods, commanded them all to be deſtroy'd by fire and ax; and, Mr. *de la Pryme* does not at all queſtion, but that the trees and roots, before-mention'd by *Cambrenſis* in *Pembrokeſhire* were the relicts of ſome of thoſe that were then deſtroy'd; and as for thoſe in the *Iſle of Man*, and other iſlands, they all have been cut down in time of war, and have lain, till they were grown over with the ſoil of the neighbouring grounds; and as for thoſe found in the bogs of *Ireland*, ſeveral of our hiſtorians expreſly ſay, that *Henry* II. when he conquer'd it, cut down all the woods that grew upon the low grounds thereof, the better to ſecure his conqueſt and poſſeſſion of the ſame, to keep the country in a ſettled peace, and to diſarm the enemy, who commonly truſting to ſuch advantages, are apt to rebel; Mr. *de la Pryme* further adds, that it is a very common thing for generals, even to this very day, to deſtroy all the woods that grow upon advantageous places, and faſtneſſes in an enemy's country, if they intend to keep it, and that they always do it with fire and ax.

A Child

A Child *with the* Inteſtines, *&c. in the* Thorax; *by Sir* Charles Holt. Phil. Tranſ. N° 275. p. 992.

THIS child having died about two months old, they gave the following account of its ſickneſs; that it was uneaſy and reſtleſs from its birth, and conſtantly laboured under a difficulty of breathing; that its illneſs was nothing like what they had ſeen in other children; nor could they perceive it reliev'd by any thing adminiſtred to it, tho' by the advice of a ſkilful phyſician; but it lay groaning and pining till it died; that they had always obſerv'd, when the child was undreſſed, an odd ſort of working in its breaſt; and could perceive a crawling round the ribs and breaſt on both ſides, as if a knot of ſmall eels, or large earth-worms, had been pent up within its cavity.

Upon opening the *Abdomen* there appear'd none of the *Viſcera* belonging to the belly, excepting the liver, kidneys, *Veſica urinaria*, and *Inteſtinum rectum*; we at firſt imagined that the other inteſtines might be cover'd by the liver, which (tho' commonly large in children) here exceeded the uſual ſize; but, upon turning it up towards the diaphragm, we only found under its concave part, the ſtomach, not lying in its natural poſition, for the *Pylorus* was drawn by the *Duodenum* croſs the *Vertebræ* of the back towards the bottom of the ventricle, and part of the *Duodenum* paſſed thro' a *Foramen* in the diaphragm, placed on the left ſide of that, thro' which the *Gula* deſcends, which occaſioned the *Pylorus* to lie almoſt under the *Fundus ventriculi*; we then reſolved to trace the *Rectum* from the *Anus* upwards, not doubting, but that it would lead us to the *Meſentery* and inteſtines; the *Rectum* lay in an oblique line from the *Anus* to this new *Foramen*, and was received into it with a portion of the *Duodenum*; this *Foramen* ſeem'd to be form'd by nature, from the child's firſt formation for tranſmitting thoſe guts into the *Thorax*; for had it been made by any force, its ſides would have appear'd wounded, or lacerated; but on the contrary, round this orifice, there was a round verge, as is ſeen in the pervious *Foramen* of the *Vena Cava*, or that, by which the *Gula* deſcends; when we took off the *Sternum*, we ſaw the *Meſentery* with the inteſtines in the cavity of the *Thorax*, lying upon the heart and lungs; there was no *Omentum* ſpread over the inteſtines, which was entirely wanting, as was likewiſe the *Mediaſtinum*; moſt part of the *Duodenum* lay in the *Thorax*, and all the reſt of the guts excepting the *Rectum*, which

aſcended in an oblique line from the *Anus*, and its upper part was inſerted into this orifice; we then began to conſider, how this child, according to the common notions of nutrition, could be nouriſhed; that it was nouriſhed, ſeems plain, becauſe it daily received food, and regularly voided the *Fæces*; ſo we propoſed to enquire what communication there was between that gland, or glands, in the middle of the meſentery (commonly called *Pancreas Aſellii*) and the *Receptaculum Chyli* placed between the internal lumber muſcles, called *Pſoas*; but upon the moſt accurate ſearch, there was none to be found; for the whole meſeraic membrane, and inteſtines, lay perfectly looſe upon the heart, and lungs, abſolutely diſengaged from any other part; that vermicular motion, which ſhewed itſelf on the ribs and breaſt, we aſcribed to the periſtaltic motion of the guts; and the *Dyſpnœa*, or difficulty of breathing, we thought might be occaſioned by the preſſure made upon the lungs by the inteſtines and meſentery, which likewiſe ſo filled up the *Thorax*, that there wanted room for the lobes of the lungs to move freely in, and conſequently, inſpiration and exſpiration were performed with difficulty.

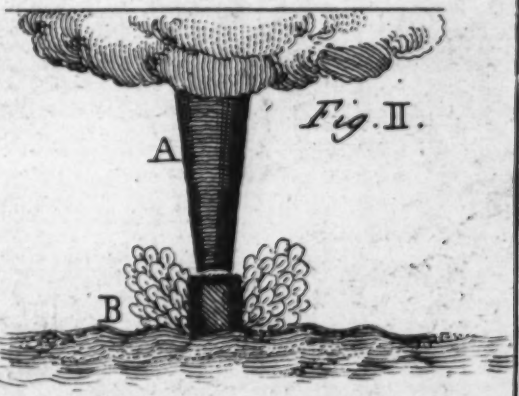
Plate III. Fig. 1. *a* ſhews the *Foramen*, thro' which the *Vena Cava* paſſes; *b* the *Foramen*, thro' which the *Gula* deſcends; *c* the *Foramen*, thro' which part of the *Rectum* and *Duodenum* went into the *Thorax*.

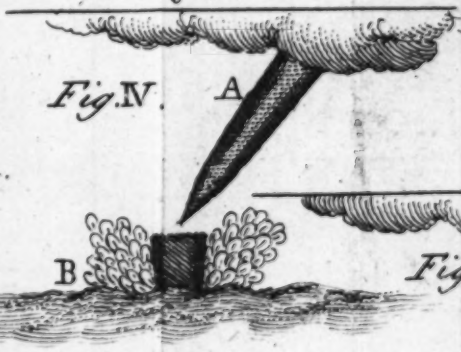
A further Account of a Diſeaſe caus'd by ſwallowing Pebble-ſtones; *by the ſame.* Phil. Tranſ. N° 275. p. 995.

GOBSIL (whoſe caſe is in Phil. Tranſ. N° 253.) came to Sir *Charles Holt*, and told him the pebble-ſtones grew very troubleſome to him, that of late he had vomited up two of them, which Sir *Charles* cauſed to be weighed, and found one to weigh two drachms, and the other one drachm two ſcruples and a half; the patient complain'd that his ſtrength was of late much impair'd; that he voided great quantities of blood by ſtool, which kept him very weak; his appetite was much impair'd, and would retain ſcarce any thing; his hands were paralytic, always extremely cold, and his fingers contracted; he was not able to open them without help, nor could he keep them ſo, unleſs it was by force; his legs were very likely in a ſhort time, to be as uſeleſs to him, as his hands; for, he ſaid, they began to fail him, and in the ſame manner to grow cold, and have little feeling in them; but, the moſt remarkable of all his com-

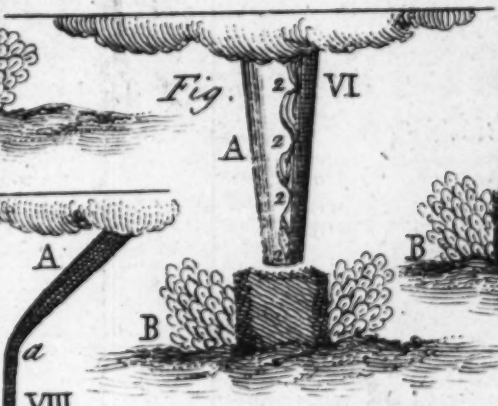

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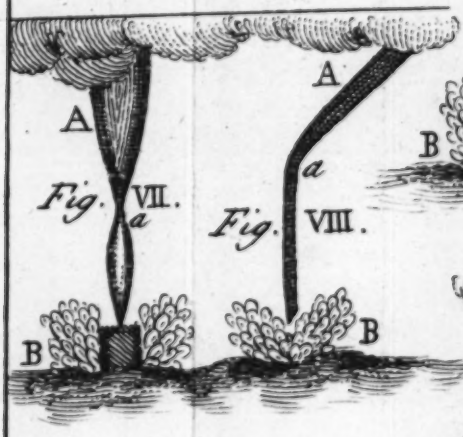




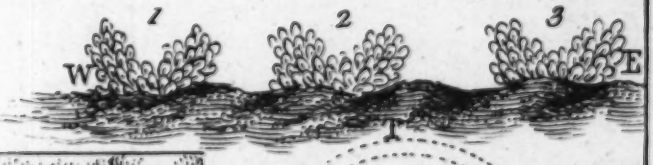


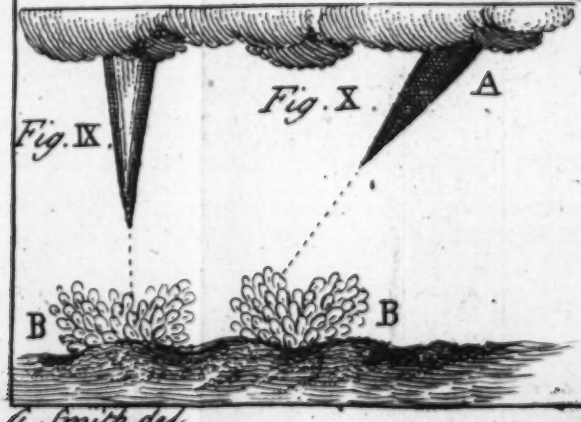


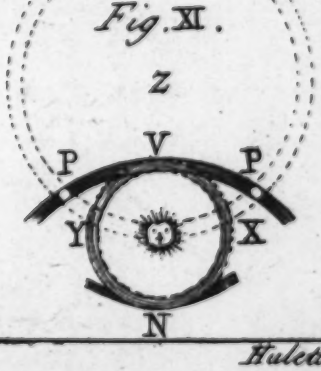












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complaints, was, a new progreſs, the ſtones had either found, or made; formerly at night in bed, they uſed to get up, as he expreſs'd it, to his heart, and upon turning to his knees, or ſtanding upright upon his legs, they would drop one by one ſo diſtinctly, that they might be counted, and in this ſtate, they always aroſe ſtreight up, on the right ſide of his breaſt; but now, they roſe obliquely, and got under his right arm, inclining towards the *Scapula*, and when they were in this place, by giving him a blow with the fiſt on his right ſhoulder, they would all fall down in a lump together, and might very plainly be heard to claſh on the other ſtones, which lay, as they did formerly, juſt above the *Os Pubis*; the matter of fact prov'd true as he related it, Sir *Charles* having made the experiment before Drs. *Fowke* and *Davies*.

Powder'd Blue *paſſing the* Lacteal Veſſels; *by Dr.* W. Muſgrave. Phil. Tranſ. N° 275. p. 996.

TO account for fevers, and the obſtruction of the glands, (from which moſt, if not all fevers proceed) we muſt admit of crude, and otherwiſe vitiated chyle, as well, if not oftener, than the external accidents from cold and heat, and the diſorderly temperature of the air; which appears from Dr. *Liſter*'s experiment, afterwards confirm'd by Dr. *Muſgrave*, *viz.* that a dog kept long faſting, would not only admit into the lacteals a tinctur'd liquor, but a very ſubſtantial one, ſuch as powder'd blue.

Dr. *Muſgrave* injected into the *Jejunum* of a dog that had but little food for a day before, about twelve ounces of a ſolution of indigo in fountain water; and three hours after, opening the dog a ſecond time, he obſerv'd ſeveral of the lacteals of a blueiſh colour; which, upon ſtretching of the meſentery, did ſeveral times diſappear; but was moſt eaſily diſcern'd, when the meſentery lay looſe, which is an argument that the blueiſh colour was not properly of the veſſel, but of the liquor contain'd therein: A few days afterwards, repeating the experiment, in another company, with the ſolution of ſtone-blue in fountain-water, and on a dog kept faſting 36 hours; he ſaw ſeveral of the lacteals become of a perfect blue colour, within a very few minutes after the injection; for, they appear'd ſo, before the Dr. could ſew up the gut: Afterwards, having kept a ſpaniel faſting 36 hours, and then ſyringing a pint of a deep decoction of ſtone-blue with common water, into one of the ſmall guts, and three hours afterwards, opening the

the dog again, he ſaw ſeveral of the lacteals of a deep blue colour, and upon cutting them, they afforded a blue liquor, *viz.* ſome of the decoction, running forth on the meſentery; after this the Dr. examined the *Ductus thoracicus*, on which, together with other veſſels near it, he had upon his return, made a ligature, and he ſaw the *Receptaculum chyli*, and that duct, of a blueiſh colour, not ſo blue, indeed, as the lacteals, from the ſolution mixing with *Lympha*, in the *Receptaculum* and near it; but much bluer than the duct uſes to be, or the lymphatics under the liver (with which he compared them) were: In each of theſe experiments, the Dr. had the aſſiſtance of ſeveral phyſicians, who all agreed with him, as to the colouring the lacteals.

The entrance into the lacteals (which is much the narroweſt part of all the paſſages from the mouth to the maſs of blood) being thus prov'd, beyond exception, to be wide enough to admit ſo groſs a body, as ſtone-blue, we may here in part explain the admiſſion of liquors, as of diuteric waters, *&c.* into the veſſels in great quantities, and that in a very little time; the ſame wideneſs of the lacteals makes them ready to receive thoſe groſſer bodies, convey'd in proper vehicles, which afterwards compoſe the grumous part of the blood, the cartilages, and bones; and this open entrance being allow'd, it will no longer ſeem impoſſible, that with our nouriſhment, eggs, or, *Animalcula* themſelves, ſhould enter theſe veſſels; there being no manner of queſtion, but that of both the one, and the other, ſome are much leſs in bulk, than the greateſt particles of indigo, in the decoction above mention'd, ſeen in the lacteals; beſides, the ſeveral other ſpecies there are of ſmall inſects, and their great fertility; when we conſider, how numerous and various thoſe of the animal kingdom are, that a very ſmall proportion, perhaps not a quarter part, come within the view of the naked eye, then, we ſhall be the better enabled to account for the great variety, as well as numbers of inſects, obſerv'd in the juices of the animal body: But, the chiefeſt uſe of the wideneſs of the lacteal orifices, is, in deducing from thence the reception of groſs matter, ſuch as are the effects of indigeſtion, *&c.* which afterwards in the blood and *Genus Nervoſum*, many times produce ſevere diſtempers, which notion, in ſome degree, was confirmed by its firſt propoſer Dr. Liſter, *in Exercit. altera de Fontibus medicatis Angliæ Edit. Lond.* p. 48.

An Account of the greateſt Part of a Fœtus *voided by the* Navel; *by Mr.* C. Birbeck. Phil. Tranſ. N° 275. p. 1000.

THE wife of one *Raper* at *Coxwold* 12 miles from *York*, falling in labour, the midwife extracted the *Secundines*, which offer'd firſt, but could not by her beſt ſkill perceive any thing elſe remaining; the woman's body falling, and ſhe being pretty eaſy for ſome days, and the *Uterus* being contracted, the midwife took theſe *Secundines* for a *Mola*, or falſe conception; but in a week more the patient began to diſcharge plenty of fœtid matter by the *Vagina*, which continued, and in proceſs of time ſhe felt a troubleſome hardneſs on the *Hypogaſtrium*, which increaſed daily for above ſix weeks; by which the patient was brought ſo low, that they deſpair'd of her life; this lump, hardneſs, and ſoreneſs wrought upwards to the umbilical region, and continued fixed there, for about a month; at length, being exceeding painful, the neighbouring women took it for a great boil or impoſthume, and applied what they uſually do in ſuch caſes, to aſſiſt its ſuppuration, and breaking, which had its effect, and it broke upon, or rather under the navel, and then afterwards diſcharged a great quantity of a thin, fœtid, and diſcoloured liquor; the parts about it mortified, and the ulcer enlarged to that bigneſs, that a man's hand might be introduced therein; it continued exceeding painful, and emitted ſuch a noiſome ſtench, that none could endure to look upon it; ſome ſhort time after, they found ſome little bones wrought out of it, which being ſhew'd Mr. *Birbeck*, he found them to be the bones of a chil'd's finger; upon which he went to ſee her; when he had examined the place, he perceived the *Fœtus* lie in a confuſed heap, or mortified lump, for, with his probe he felt ſeveral bones, and at that time extracted (after ſeparating and dilating the mortification about it) above half the ribs, ſome of the *Vertebræ* of the back, and other bones, and cut out above a pound of the chil'd's mortified ſubſtance, as black as ink, with an exceeding nauſeous ſtench; and every 2d or 3d day for a month, he extracted what he could, being obliged to do it very deliberately, by reaſon of the exceeding weakneſs of the patient, who would have certainly died under the operation, had he forcibly extracted it, and not given her time; for, we were obliged every moment to ſupport her with cordials, and after each operation, ſhe found herſelf lightſomer, and by degrees ſweeter, which gave

Mr.

Mr. *Birbeck* hopes of her recovery; for, not only the *Linea alba*, and the muſcles of the *Abdomen*, but the *Peritonæum* and *Omentum* were mortified to a great breadth, and the inteſtines lay fairly in view, and expoſed to the air for a long time; after extracting part, and having a plentiful diſcharge of thin fœtid matter, the diſcharge downwards began to leſſen and abate, ſo, that he endeavoured to aſſiſt it by bandages and compreſſes, with deterging and drying injections up the *Vagina*; by which means in a little time there was no diſcharge that way, and thoſe parts ſoon became perfectly well; and in ſome time after, the ulcer ſeparated (with the aſſiſtance of fomentations, good digeſtives, and mundificatives) from its putrifaction, the part contracted and united; and had now been quite cicatriz'd near three months, all the *Abdomen* being ſoft, eaſy, and well condition'd; the patient laboured all the ſeaſon at hay-harveſt: Mr. *Birbeck* ſuppoſes, that by the forcible extraction of the *Secundines*, the *Uterus* had been lacerated, and this occaſion'd the ulceration; and the patient being extremely weak, and conſtant lylying a-bed, gave the more liberty for its working upwards.

Aſbeſtus, *&c. found in* Scotland; *by Mr.* Wilſon. Phil. Tranſ. N° 276. p. 1001.

IN the grounds of Mr. *Gordon* of *Achindore*, in the ſhire of *Aberdeen*, near the *Highlands*, on the ſide of a hill of a heathy kind of ſoil, ſomewhar inclining to what we call moſs; in a very ſmall brook, and alſo hard by it, for 10 or 12 yards, Mr. *Wilſon* found a great many ſtones, ſome a foot long, which plainly appeared like wood; but becauſe he could not perceive any veſtige of wood thereabouts, and becauſe none of the ſtones could be found, but in that ſpot of ground only, he could not think they were petrified wood; then upon cutting up the ground about that place with a knife, he found ſome pieces of the ſtone, and very near the ſurface ſeveral pieces of a fibrous ſubſtance, which his knife could not cut, upon which, he immediately judged this was an incombuſtible matter, as it proved afterwards, when he tried it in the fire; when he found ſome pieces of the ſtone very hard in the middle, and the fibrous ſubſtance, or filaments on the outſide and extremities, he was inclined to think that the flax came from the ſtone; but then finding ſeveral pieces of the flax ſo condenſed, that at firſt they appeared to be hard ſtones; but being a little wetted, the filaments were eaſily ſeparated from each other; he found ſeveral, more or leſs condenſed like a ſtone, and all of it, both

that

hat which was condenſed together, and that which was not, lay about an inch within the ground, parallel with the ſurface, and ſo interwoven with the fibres of the graſs-roots, without any root of its own, but a-like at both extremities, as if cut with a knife, that it ſeemed to Mr. *Wilſon* much more probable, that the flax turned into ſtone, than that the ſtone turned into flax; eſpecially, ſince moſt part of the ſtones appeared ſo tender, and brittle on the outſide, that it is difficult to conceive, how they could turn into that tough ſubſtance of flax: The ſtones are of different ſorts, ſome are white, of the colour of the flax, and of a very ſoft ſubſtance, ſo that they may be eaſily cut with a knife; others are much mixed with a whitiſh *Talc*; but moſt of them are of a greyiſh colour, and very hard; the ſoil wherein it is found, is of a greyiſh colour, about an inch or two thick, under which, there is a black ſoil a foot deep; ſo that he could find nothing in the places, where moſt of it was got, from which, he could rationally conclude, it was produced; but in ſome other ſpots, he found a deal of *Talciſh* ſand, with ſome pieces of flax near it; as alſo ſome pieces of the ſtone much whiter than the reſt, and very like *Talc*, from which it is probable it was produced; yet there being no appearance of any *Talc* in the other places, where moſt of it was found, he could ſcarcely conclude any thing about its production.

Pliny, *Aldrovandus*, & *Olaus Wormius* make *Asbeſtus* to be very ſhort, whereas ſome of what Mr. *Wilſon* found was 5, 6, and ſome 8 inches long; as for the making of it into cloth, they all conclude it very difficult; yet it may be ſeen, by an experiment of Mr. *Wilſon*'s in making yarn of it, that cloth may alſo be made thereof; for the difficulty is much greater in the one, than in the other.

The ſtrange Bones *and the* Iſthmus *between* Dover *and* Calais *further conſidered*; *by Dr.* Wallis. Phil. Tranſ. N° 276. p. 1022.

MR. *Luffkin* ſuppoſing in (Phil. Tranſ. N° 274.) that the large bones found in a gravel-pit, near *Harwich*, much like thoſe found at *Chartham*, were rather thoſe of an elephant, than of an *Hippopotamus*, or other marine animal; Dr. *Wallis* thinks, which ſoever it is, that it will equally prove thoſe valleys to have been much deeper in former times, than now; the Dr. obſerves, that the river in *Eſſex*, and that in *Kent*, near which the bones were found, are both of them

called the *Stoure*, which, whether it be a corruption of the *Latin Æſtuarium*, as Mr. *Somner* conjectures, or of the *Britiſh* ys-dwr, that is, the water, the Dr. will not diſpute; and, that the bones, being found, in both places, much at the ſame depth, *viz.* 16 or 17 foot, might probably have been lodged in both, much about the ſame time; and that, perhaps, when the emperor *Claudius* brought his elephants into *Kent* and *Eſſex*, as Mr. *Luffkin* intimates out of *Dion Caſſius*; the Dr. alſo obſerves, that thoſe petrified bones, in both places, were found in gravelly ſoils, as are thoſe petrified ſhells, and bodies of fiſh, in gravel-pits and ſtone-quarries near *Oxford*; how far the ſteams, fumes, or fluors of the earth, which contribute to the formation of ſtone, or gravel, might conduce to the petrifying of theſe bones, ſhells, or other bodies, he leaves to the conſideration of naturaliſts; and, whether the impregnation of ſuch ſteams might not ſwell ſuch petrified bodies, to a larger proportion, than they had before; juſt as we obſerve wood, and other like matter, to ſwell in a moiſt air, by the diſtenſion of their pores, upon the intermiſſion of moiſt particles; for, the Dr. takes all petrifactions to be cauſed, either by incruſtation, or the intromiſſion of ſtony particles; and he obſerved at *Moldaſh* in *Kent*, near *Feverſham*, on ſome high grounds, very ſtony, (which ſometimes uſed to be paſture, and ſometimes plough'd-land) divers oiſter-ſhells petrified, or partly ſo, much larger, and thicker, than the ordinary proportion of oiſters in thoſe parts, and very weighty; which oiſter-ſhells might have been purpoſely thrown there long before, as being reputed a good manure, and might have been impregnated with the like halitus, and effluvia, as are the numerous ſtones on thoſe lands.

But to return, the Dr. does not ſee, why, we may not ſuppoſe, the *Stoure* in *Eſſex*, and the *Stoure* in *Kent*, to have been, both of them, *Æſtuaries* of the northern tide, before the rupture of that *Iſthmus* between *Dover* and *Calais*; and the like, of the river near *Malden*, and other ſmall creeks on the coaſt, tho' not ſo large as thoſe of the *Humber*, and the *Thames*, which were then *Æſtuaries* of the ſame ſea, as are many others on the coaſt of *Scotland*; the Dr. ſays before the rupture; for, ſince that rupture, the caſe, as to the *Thames* is ſomewhat altered; for, the weſtern tide between us, and *France*, which was then ſtopped at this *Iſthmus*, does now flow on thro' that *Fretum*, beyond the mouth of the *Thames*, as high as the *Dogger-ſands*; which therefore, ſupplies the *Æſtu-*

ary of the *Thames*, which was formerly furniſhed from the northern ſea; and theſe ſmaller *Æſtuaries* might ſooner be choak'd up, by what every tide lodged there, while thoſe larger *Æſtuaries* are but ſhortened, and become narrower than they had formerly been; and, as to the *Thames* in particular, it ſeems very evident, if we conſider their ſituation and the nature of the ſoil, that much of the low grounds in *Kent*, and *Eſſex*, on both ſides of the *Thames* mouth, adjacent to the ſea, had formerly been ſea, as well as that of *Romney-marſh*; and when the mouth of the *Thames* was ſo much wider, no doubt, but the ſea flowed much farther than now it does, but how far, no one can determine.

It may, perhaps, be objected, that the little rivers ſtill remaining in the bottom of theſe valleys, which may be ſuppoſed to have been *Æſtuaries* in former times, do now run with more windings and turnings, than theſe valleys themſelves do; but this need not at all ſeem ſtrange, when we may daily obſerve the ſame, in the bottom of a muddy ditch, or water-courſe, when the water is almoſt drained off, the mud ſtill remaining ſoft; that the little water, which is left, will work out for itſelf amidſt the mud, a winding paſſage (according as the mud will give it way more or leſs, much more crooked than the ditch itſelf when full of water; and the like muſt needs happen in the gradual draining of ſuch *Æſtuaries*, according as the ſoft ſoil will permit; which curvity will ſtill continue, when the banks on both ſides do by degrees become firmer: As to what the Dr. obſerved concerning the iſle of *Oxney*; a low level in that iſle, which had for ſeveral years lain under water, is now raiſed by introducing the tide, to a conſiderable height above what it was formerly; and the channel from thence to *Rye*, is, by the tides flux and reflux, become much wider and deeper than heretofore: If we look in the more ancient maps of *Kent* before the year 1640, we ſhall find, that what we call the iſle of *Oxney*, was then but a *Peninſula*, being continued (by a ſmall *Iſthmus* at the north-eaſt corner thereof) to the reſt of the country; and the tide from *Rye* to that place, which now flows ſtreight on by the north-ſide of the iſle, was there ſtopped by that *Iſthmus*, and wheel'd about on the ſouth-ſide thereof; or rather, the river *Rother*, did from the north-ſide of the iſland, wheel about by the ſouth-ſide to that eaſtern corner, and thence by the channel to *Rye*; while things were in this ſtate, divers mooriſh or marſh-

lands adjoining to the river *Rother*, were often in danger, upon great rains, of being overflowed; but ſo it happened once, that this drown'd land had unexpectedly, in one night's time, or more, diſcharged itſelf on another level ſomewhat lower; upon which indication it was thought adviſable, by cutting that *Iſthmus*, to allow thoſe waters on the north-ſide of the iſland a ſtraiter paſſage towards *Rye*; and to let thoſe lower grounds lie for ſome time under water, till by introducing the tide, they might be ſomewhat heightened, and then timely recovered.

Of the Invention and Improvements of the Mariners Compaſs; *by the Same*. Phil. Tranſ. N° 276. p. 1035 *and* 1106.

DR. *Wallis* is of opinion, that the mariners compaſs was originally an *Engliſh* invention; not only, becauſe the *Engliſh* have been of old as famous for navigation, as any other nation, long before the *Holland* ſea-trade was in being, and a long time after; but (ſince new inventions commonly take their names from the place where they are made) from the name compaſs; which is an ancient *Engliſh* word, for what we otherwiſe call at this time a circle: In *Kent* it was commonly uſed in that ſenſe, when he was a youth; and *Minſhew* in his dictionary takes circle, and compaſs, indifferently to ſignify the ſame with *Circulus*; and hence it is, that *Circinus* is in *Engliſh* called a compaſs, or pair of compaſſes, as being the inſtrument where-with we deſcribe a compaſs or circle; but whether *Circinus*, called by us a pair of compaſſes, may have ſome ſuch name in another language, or how anciently, the Dr. does not know; nor can he determine, whether the word compaſs, or any word like it, was ever uſed in any other language for a circle indefinitely, or for any other circle, than the *Circulus nauticus*; in *French* it is *Cercle*, in *Italian Cerchio*, in *Spaniſh Circulo*, or ſome other word derived from the *Latin Circulus*; and from hence the *Circulus nauticus* may come to be called the mariners compaſs, which name being given it by the firſt inventors, might give occaſion for the like names in other languages, *French*, *Italian*, *German*, &c. compaſs, *Compaſſo Zee-compaſs*, &c. which name, together with the art, the Dr. conjectures they borrowed from *England*: He might, he ſays, urge the ſame thing from another name, *Boſſolo*, *Boſſola*, &c. For, as *Circulus nauticus* is the mariners compaſs, ſo *Pyxis nautica*, is the mariners box, for the *Engliſh* word *Box* is from the *Latin Pyxis*, and *Pyxidula*, as a diminutive from *Pyxis*, muſt

muſt be *Boxel*, or ſome word like it, which eaſily paſſes into the *French Buxole*, *Bouſſole*, and the *Italian Boſſola*, *Bouſſula*; all which ſeemed to be derived from the *Engliſh Boxel*, *Pyxi-ula*, or a little box, ſoftening the ſound of the letter *x* into *ſſ*, as in *Aleſſandro* for *Alexandro*: All which tho' it be not a direct demonſtration, yet (ſince it is not agreed by whom, or where the compaſs was invented) may in the ſilence of hiſtory be admitted as a probable conjecture, and a plauſible pretence to the invention, till a better claim appears; and where inventions creep in by degrees, it muſt not be thought ſtrange, if it be not eaſy to ſay who is the firſt inventor: In the preſent caſe, he who firſt obſerved that the magnet had a polarity, or inclination northward, made the firſt ſtep towards this invention: This was at firſt wont to be ſhewed, by putting a magnet into a little boat, ſwimming on water, when it was obſerved, that this magnet would of itſelf ſo ſteer this little boat, as that a certain point of the magnet would (if not hindered) turn towards the north; which point was thereupon called the magnet's north pole; he that afterwards obſerved, that this verticity, or polarity, was communicable to a piece of iron, or ſteel, rubbed on a magnet, added a further ſtep; and he who contrived a way to ſet a needle, or piece of ſteel, ſo touched on a ſharp pin, as in the air to move horizontally thereon, and of itſelf find out the north, and point towards it, as the ſwimming magnet had done before in its boat on the water, had now diſcovered a new experiment in natural philoſophy, very ſurpriſing; but this cannot yet be called *Circulus nauticus*, or the mariners compaſs, till they had further contrived, how to put a needle thus poiſed into a box, with a compaſs or circle round it, divided in ſuch a manner, as to denote the azimuthal points of the horizon, or as they are now called, the points of the compaſs; and commodiouſly fix this box ſo prepared, to the ſhip, as thereby to inſtruct the mariner, or ſteerſman towards what point of the compaſs the ſhip moved; that by the help of the rudder he might put it into ſuch a courſe, as was proper for his voyage; and it was now, indeed, *Pyxis nautica*, or *Circulus nauticus*, the mariners box, or compaſs, but not till then; and he who firſt contrived this application, did complete the mariners compaſs; but all thoſe antecedent diſcoveries were ſteps towards it, and part of the invention: Now it is not likely, that all theſe diſcoveries were made at once, by the ſame man, at the ſame time, but ſucceſſively

ceſſively, by the joint advice of divers inquiſitive men, and in a conſiderable tract of time; yet all perhaps, of the ſame nation, and probably the *Engliſh*: But, whoever gave the firſt hint of this invention, certain it is, that the great improvements of the magnetic doctrine are due to the *Engliſh*, and chiefly to thoſe about *London*, and *Greſham College*.

The caſe is much the ſame with the art of printing, which we cannot reaſonably ſuppoſe to be invented all at once, nor perhaps all by the ſame man; but rather by ſeveral concurrent hands, and in a conſiderable tract of time, before it came to that degree of perfection, to which it is now arrived: It might be firſt obſerved, that the ſhape of a letter, figure, or picture, graved on wood, or metal, might by the help of a convenient preparation of oil, ink, or coloured liquor, be ſtamped on paper; and if once, then as often as you pleaſe: but, this being admitted, it remains further to be contrived how ſeveral types, or ſtamps for a whole page ſhall be ſo compoſed into one frame, that the paper may be applied to all at once; it is then to be conſidered further, what kind of ink, is to be applied to the face of the letters, thus compoſed; for common writing-ink will not ſerve the turn; then how the paper ſhall be applied, with an equal and ſufficient preſſure, ſo as to take off juſt ſo much of that ink, as repreſents the figure of thoſe letters, and no more; and after all this, it muſt be further contrived, how to erect ſuch a machine, as what we now call a printing-preſs, and how to manage it, ſo as to anſwer all theſe exigencies; for till all this be done, we are not arrived to what we call printing; yet theſe previous contrivances muſt be owned as parts of the invention; and thus it is likewiſe in the doctrine of magnetiſm; and to thoſe previous diſcoveries, muſt be added the ſubſequent improvements made therein, ſince the firſt uſe of the mariners compaſs, of which whoever was the firſt inventor, it is certain, that the doctrine of the magnet has received very great improvement from the *Engliſh*, *viz.* *Blagrave*, *Gunter*, *Gellibrand*, *Gilbert*, *Norwood*, *Wright*, *Briggs*, *Foſter*, &c. as alſo from Captain *Halley* in his map of the magnetic variations, which are thereby fixed in thoſe ſeas for the preſent time.

The Dr. takes it to be agreed on by all, that what we call the variation of the needle, is an *Engliſh* diſcovery, *viz.* of Mr. *Gellibrand*, one of the profeſſors at *Greſham College*, about the year 1625; that is, that the magnetic needle in its horizontal

ontal poſition does not retain the ſame declination, or varia-ion from the true north, in the ſame place, at all times, but aries ſucceſſively that declination from time to time; which, ho' it was about that time, a new diſcovery, is now admitted s an undoubted truth: It was about the beginning of King *Charles* the I. that Mr. *Gellibrand* cauſed the great concave ial to be erected in the privy-garden at *Whitehall*, to fix a rue meridian line, and with a large magnetic needle, ſhewing s variation from that meridian from time to time; and the Dr. thinks it would not be amiſs, if exact obſervations were ow made, whether the meridian be juſt the ſame, as it was hen; for it is very poſſible, that the pole of the earth may in ime ſuffer ſome little variation, which may not readily be diſ-erned, that may cauſe an alteration of the meridian line; and his, if it is ſo, will be more diſcernible nearer the pole, than arther off.

What we call the dipping-needle, is admitted alſo to be an *Engliſh* diſcovery, to wit of Mr. *Blagrave*, which is ſomewhat lder than the former; that is, that the magnetic needle, be-ides its horizontal direction towards the north, has alſo a di-ection of altitude above the horizon, if ballanced on an hori-ontal axis, pointing, as it were, with its northern extremity n our climate to ſome point within the body of the earth; whether or not this direction varies from time time, as does hat of its horizontal poſition northwards, the Dr. cannot tell, nor does he know, whether or not it has been obſerved, nor whether the ſouthern extremity in other parts of the world lips, as the northern one does with us.

It is alſo an *Engliſh* obſervation, that not only a magnetic eedle, but any piece of iron, if kept long in the ſame poſi-ion, ſhall of itſelf contract a polarity; as for inſtance, an rect bar in a window, after long continuance in that poſition, will, if duly poiſed, be found with its upper end pointing to-wards the north, and with the other towards the ſouth; and if fterwards, it be continued long in a contrary poſition, it will ttain a contrary polarity; and Mr. *Gilbert*'s notion (of the arth's whole body being but one great magnet, and leſſer nagnets ſo many *Terellæ* or little earths, ſympathiſing with he whole) is *Engliſh* alſo: It hath been likewiſe obſerved, hat a magnetic needle, if heated red hot, will loſe its pola-ity; and if then cooled in a contrary poſition, it will acquire contrary polarity: It has further been obſerved by our *Eng-iſh* mariners, and that more than once, that upon a great

flaſh

flaſh of lightning at ſea, their magnetic needle has loſt its former polarity, and acquired the contrary; in general, the doctrine of magnetiſm has been more improved by our *Engliſh* naturaliſts, than by any other nation.

The Way of taking and taming Elephants *in the Iſland of* Ceylan; *by Dr.* Strachan. Phil. Tranſ. N° 277. p. 1051.

ALL the natives within 20 miles of the ſea-coaſt, betwixt *Matura* and *Negumbo*, are ſubject to the *Dutch*; and therefore, when they have orders from the *Eaſt-India* company to hunt the elephants, they pitch upon a convenient place for a warren or park, which is broad at the entrance, and the farther you go, the narrower; ſo that at the extremity it is ſo narrow, that an elephant cannot turn itſelf; yet, this narrow place is ſo long, that 20 elephants may ſtand one behind another; the park being finiſhed, the *Koolrale*, who is the head or chief of the *Kool*, or county, orders the inhabitants, who dwell thereabouts to their places; who ſurround the woods, where they know elephants are, for about 60 *Engliſh* miles in circumference; at firſt, each man ſtands from the other at the diſtance of 5 poles, or 25 yards, and kindles a fire in the intermediate ſpaces; and then by ſhouting, beating of drums, and ſounding of horns, the elephants retire towards the park; and ſo the natives follow them by degrees, ſhouting, and making a noiſe, till the circumference become ſo ſmall, that they ſtand cloſe by each other; the elephants, when they find themſelves incloſed within the park, make the more reſiſtance, and ſome of them turn upon the natives; but poſts are ready ſtanding betwixt them and the elephants, and there are long ſtakes lying upon the ground; ſo that they need only lift theſe up, and faſten them at both ends to the poſts, and thus the elephants are incloſed; then by following the elephants, and throwing of fire-brands, they chaſe them ſtill farther towards the end of the park, and cloſe up the paſſage behind them, by ſetting up, and laying ſtakes a-croſs the poſts, till at laſt the elephants are all entered into the narrow place, where they cannot turn themſelves; there are ſeveral ſorts of elephants, ſome a great deal higher before than behind, and ſeveral never have the two long teeth; others are of a more ſavage nature, known by their fierce looks, which are of no ſervice, tho' kept for 10 years; ſuch as theſe the King of *Candie* has for puniſhing tranſgreſſors, for they kill all that come within their reach; ſuch like elephants being among the others in the aforementioned park, are kept out of the narrow entrance, by throwing

g fire-brands at them, when they draw near it; and the na-
ves endeavour to kill them with ſhooting, and cutting off
eir trunks, by which they take all their food; and thus, when
ey eſcape, they periſh with hunger; for the natives being very
wift, come very near them with their ſwords; when all the
hoice of the elephants enter the narrow paſſage, there are poſts
ut a-croſs, ſo that none of them can come back; and ſuch as are
ot fit for ſervice, have liberty to eſcape.

It is eaſy to conceive, how the natives invented the method of
unting elephants with drums and ſhouting, becauſe it is ob-
rved they themſelves are affrighted by drums: Dr. *Strachan*
as told by an old *Portugueſe*, that when his countrymen were
poſſeſſion of this iſland, and purſuing the natives too far up in
e woods, and hills, the *Ceylaneſe* by this means killed every
an of them, excepting one drummer, who obſerving, that they
d not draw near where they heard the drum, he kept continu-
ly beating on his drum; and the *Ceylaneſe*, imagining that the
reateſt power was where the drum beat, did not come near
im, and ſo he ſaved his life: When the elephants have been
me time ſettled in the narrow paſſage, they are taken one by
e to the ſtable, being tied faſt between two tame elephants bred
r that purpoſe, the point of whoſe long teeth are cut; if the
ild elephant is unruly, they hold his trunk with their trunks,
d beat him with their teeth; and a man ſits upon each of the
me elephants and directs them with a ſtaff, upon the end of
hich is a hook, wherewith he touches his head, and orders the
ephant as he pleaſes, without either bridle, or any ſuch thing;
hen they come to the ſtable, they are laid between two poſts,
ith ſtakes a-thwart before their breaſts, and under their bellies,
d bound in ſuch a manner, that they cannot ſtir, nor lie down
on the ground; for ſhould they be permitted to lie down, they
ould become heavy, ſorrowful, and would not eat, but die;
us, they are fed with the trunk of *Waltugas*, or *Plantains*;
e trunk of which tree they love better than any other food, and
erewith they are alſo fed in the ſhip; when they have been ſo
d for ſix weeks, they begin to be tractable, and are faſtened
ly by one foot with cords; and if the merchants come from
engal, they are ſold and conveyed to the ſhips; but if they
not buy them, they are fed with the leaves of the *Cocoa* tree,
l 12 weeks after they were taken; and then they are as tame as
dog, and eat graſs with the oxen in the fields; when an ele-
ant is put a-board, there is a contrivance made of 15 or 20
uble ſail-cloths, which is laid about his breaſt, belly, and ſides,

and tied together upon his back, to which ropes are faſtened; then he is led into the water, betwixt elephants bred for that purpoſe; upon which a man ſits to direct him, and another elephant, upon which a man alſo ſits, goes behind the elephant that is to be ſhipped; and when this is unwilling to enter the water the other that is behind, putting his head to the hinder parts of the foremoſt, puſhes him forwards; and when he is got deep enough in the water, he is tied to the boat, the other elephants return, and he ſwims after the boat to the ſhip, where he is haled on board; but there is a more convenient method, which is this; they prepare a large flat-bottom'd veſſel, covered with planks like a floor, ſo that this floor is almoſt level with the quay, then the ſides of the quay, and veſſel are adorned with green branches, ſo that the elephant ſees no water, till he is aboard; when an elephant ſwims to the ſhip, or croſſes a deep river, there is nothing ſeen of him but his trunk, thro' which he breathes; and when he is waſhed upon a river-ſide, he ordinarily lies with his head beneath the water level with his body; aud tho' one ſide be above water, his head will be under, holding only his ſnout above it, thro' which he breathes: When the elephants are tame, they are very docile and tractable, ſo that they will lie down on their belly, when men are to get up and ride upon them; if they fall at any time, tho' on plain ground, they either die immediately, or languiſh till they die, their bodies being ſo bulky, cauſes the harm they receive by a fall; If an elephant frequents a plantation of fruit-trees belonging to the natives, for no hedges can keep him out, they point a heavy piece of wood, and hang it by a cord on the branch of the tree, under which the elephant uſes to come; and at night a man ſits watching upon that branch, and as ſoon as the elephant comes, the man cuts the cord, and ſo the pointed wood falls a foot deep into his back, by which means the elephant languiſhes, and dies.

An Account of a ſtrange Cancer; *by Mr.* Kay. Phil. Tranſ. N° 277, p. 1069.

MR. *Kay*'s father had a cancer, which took its riſe from a ſmall bruiſe on the *Os Jugale*, and in proceſs of time ſpread itſelf over all the cheek; and notwithſtanding the endeavours of the moſt eminent ſurgeons in thoſe parts where he lived, it ulcerated his eye quite round, which Mr. *Kay* ſaw him take out with his own hands; and afterwards extended itſelf to his ear, and thro' his cheek into his mouth, and a-croſs the upper part of his noſe, and perforated the bone there; it likewiſe over

over ran that ſide of his fore-head, fouling the *Os Frontis*, which came away in pieces, leaving the *Dura Mater* bare, for the breadth of a half crown, which riſing thro' the perforation of the *Cranium*, in a few days putrified, and expoſed the brain itſelf to view, ſeveral portions whereof came away freſh, and untainted; and what was moſt extraordinary was, that he perfectly retained his ſenſes, and roſe every day to dreſs the ulcer himſelf, till a conſiderable quantity of the brain was come away; and when he was confined to his bed, his ſpeech failed firſt, and about four days afterwards, he died; his brain being totally conſumed, and nothing remaining in the *Cranium*, but a ſmall quantity of black putrid matter; he had neither *Spaſmus*, nor convulſions of any part, all the time of his illneſs.

Natural Curioſities; *by Mr.* Ralph Thoresby. Phil. Tranſ. N° 277. p. 1070.

MR. *Thoresby* had in his *Muſæum* the outer ſkin of the maw of a fiſh taken at *Macaſſar*, which was given him by Mr. *Midgley*, who had it from a *Dutchman* at *Batavia*, who took it out of the fiſh; the fibres, or veſſels do curiouſly and naturally reſemble a tree, with its ſtem, branches, leaves, *&c.* the ſkin is very thin, whitiſh and tranſparent; and the veins that compoſe the ſtem, and the larger branches, are now rather black than dark red; the leaves are of a ſort of dark and faded green, variegated: Mr. *Thoresby* had a flint, brought from *Milan*, which had ſomewhat within it reſembling ſpar, that ſeemed to differ from the reſt of its ſubſtance; tho' after all, ſpar, being nothing elſe but a cryſtalline ſort of lime-ſtone, does not differ from a flint in reality, but only in appearance, that is, in the manner of its concretion; and if the incloſed ſubſtance had differed in its nature from the reſt of the ſtone, the thing had not been very uncommon; for ſtones, eſpecially thoſe of a globular or oval form, have uſually coat upon coat; and theſe coats are ſometimes very different from each other, ſome being ſoft, and others hard; nay, ſometimes, after a long time, one of theſe coats will ſhrink from the other, after the manner of a kernel, when the ſhell becomes dry; and then, if the incloſed ſubſtance continues ſoft, and marly, they call that ſtone *Geodes*; but if ſtony, it makes one of thoſe rattling ſtones, that are known by the name of the *Ætites*, or eagle-ſtone; many inſtances might be brought, to confirm, that it is no unuſual thing for ſtones to incloſe ſubſtances of a very different nature from themſelves; as appears by the ſhells in *Suſſex* marble; and the ſtones found in the *York-*

ſhire coal-pits, known among the colliers by the name of cat-heads; they are found in a particular *Stratum* near the coal, and incloſe a fern, or ſometimes a polipody-leaf in the middle; and for that reaſon, being ſtruck with a hammer, they break very readily there; they ſeem to be a ſort of iron-ſtone, a-kin to what they call in *StaffordſhireBallmine*; and Dr. *Liſter*, *Minera ferri pilæ-formis*; they have it upon the weſtern coaſts near *White-haven*, and call it there by the name of *Cat-ſcamps*; and Mr. *Thoresby* has ſeen of it likewiſe upon the *Yorkſhire* coaſt in *Robin Hood's Bay*; and calls it *Lapis mineræ ferri, pilæ-formi ſimilis in cujus meditullio, unum vel plura filicis folia repreſentantur*, he had ſpecimens of both ſorts; and that one and the ſame piece of rock does not always ſhoot into a ſtone at one and the ſame time, but at firſt one part, and then another, and that not after the ſame regular manner; he had a piece of rock-cryſtal, wherein might be plainly obſerved, that the *modus concreſcendi* in the middle differed from that of the outſide; nay, ſometimes, he ſaw in the middle of ſome tranſparent ſtones, a little drop that never would take the ſolid form of the reſt of the ſtone at all: Mr. *Thoresby* had alſo a piece of an iron-bolt, two inches long, found in a ſtone-quarry, and turned into iron-ore again; this being a property which iron has and no other metal, as Dr. *Liſter* obſerved in his journey to *Paris*; he had likewiſe from *Sweden* a piece of copper-ore regularly ſhot into an octohedron; it had eight ſolid triangles, and conſequently ſix angular points; it was found in the copper-grooves at *Fahlum*, where ſeveral of the ſame figure were found at the ſame time.

Subterraneous Trees *in* Hatfield-chace; *and a remarkable* Hydrophobia; *by Mr.* de la Pryme. Phil. Tranſ. N° 277. p. 1073.

MR. *de la Pryme*, being at *Hatfield* in 1702, was told by ſeveral gentlemen, that about 20 years before, died one *Saunderſon* of that town, aged near 80; whoſe father, much of the ſame age, had frequently aſſured him and others, that he could very well remember ſeveral hundreds of large tall fir-trees that grew in theſe levels, ſtanding here and there, in a languiſhing condition, whoſe tops were all dead, yet their boughs and branches were always green, and flouriſhing; and *John Hatfield* Eſq; who was not above 40 years of age, had by him a large twig, which his father had plucked off from a green and flouriſhing ſprout of firr that grew from the great root of one of the ſame kind in theſe commons; and an old man of *Croul* heard his

his father ſay, that he could remember great numbers of ſhrubs and ſmall firr-trees growing there before the drainage, and while this place was a chace, and the vert preſerved; and laſtly, by ſeveral old charters Mr. *de la Pryme* had ſeen of *Roger de Mowbray*, Lord of *Axholm*, who liv'd in the year 1100, relating to *Hurſt*, *Bellwood*, *Roſs*, *Santoft*, &c. it appears, that all theſe places were then covered with a large old decay'd foreſt or wood; as alſo, all that low common between *Croul-cauſeway* and *Anthrop* upon *Trent*; and tho' there is not the leaſt veſtiges of any ſuch thing now to be ſeen, yet it is not only plainly manifeſt, that it was a foreſt formerly, from the roots found there; but alſo, from the ſaid roots it appears, that moſt of the trees which grew there were firrs; all which were but the after-growth, and relicts of the large foreſt deſtroyed by the *Romans*.

Mr. *de la Pryme*'s brother had a grey-hound bitch that had whelps; ſoon after, a mad dog bit this bitch, upon which three weeks after, running mad, they were obliged to kill her; but, ſaving her whelps, becauſe no ſigns of madneſs appeared in them, in about three weeks more they pull'd out each others throats, excepting one which eſcap'd; at length perceiving that it could not lap, nor ſwallow any thing liquid, ſome of the ſervants put their fingers into its mouth, and felt its tongue and throat, but diſcovering nothing amiſs therein, they let it alone a day or two longer, and then it ran mad, and died; about three weeks after, one of the ſervants who was a very ſtrong labouring man, and had frequently put his fingers into the whelp's mouth, began to be troubled with an exceeding acute pain in the head, ſometimes once, and at other times twice a day, ſo very vehement that he was obliged to hold his head with both his hands, to keep it from rending aſun-der; which fits commonly laſted about an hour at a time; when his throat would contract, as he ſaid, his pulſe be tremu-ous, and his eyes ſaw every thing he look'd on of a fiery red colour; thus he was affected for a whole week together; but, being of a ſtrong conſtitution, and returning to his labour, at every interval he wrought it off by ſweat, without any phy-ic; but it went worſe with one of his fellow-ſervants, about 24 years of age, who was not of ſuch a ſtrong conſtitution; he was alſo ſeiſed with a pain in his head, was, ſomewhat feveriſh, ſometimes better, and ſometimes worſe, he cough'd much, had a good appetite, eat heartily, but could drink nothing; *I know not what I ail*, ſays he; *but I cannot drink*

drink any Beer, &c. and ſo laugh'd at it; when he went out of doors, if there was but the leaſt north-wind, yet, he always ran, as if it had been for his life; and when he was aſk'd, why he did ſo, he told them, *he could not tell, but that the Wind would ſtop his Breath*; a day or two after this, he was worſe, and vomited an ugly ſort of matter, like black blood, which ſtunk like rank-oil but much ſtronger, and this he did ſeveral times; after which, he would be pretty well, and walk about, but moſt commonly he ran as faſt as ever he could, firſt out of one corner, then into another, then up ſtairs, and down again; but upon the third day of his confinement within doors, he became perfectly mad, would ſtart, leap, and twiſt his hands, and arms together, point at people, laugh, and talk any thing that came uppermoſt; in ſome of his fits he was ſo ſtrong, that four young men could hardly hold him down in the chair where he ſat; but as ſoon as they were over, he was hearty, laugh'd and talk'd; but all his diſcourſe was about fighting, and how, that if they would but let him alone, he would leap upon them, bite, and tear them to pieces; about an hour after, his fit return'd, which ſoon made him ſpeechleſs, and affected entirely his brain, and then he died.

Spouts *in the* Mediterranean; *by Dr.* Stuart. Phil. Tranſ. N° 277. p. 1077.

THE Dr. being on the 27th of *Auguſt* 1701 upon the coaſt of *Barbary*, to the northward of the town of *Bona*; upwards of 10 leagues diſtance at ſea, about 7 a clock at night, ſoon after ſun-ſet; there appeared in the N. E. which was directly up the gulf of *Lyons*, great and continued flaſhes of lightning one after another, hardly without any intermiſſion; and thus it continued till next morning, without thunder; the flaſhes of lightning ſometimes reſembled the ſudden appearance of a ſtar, and at other times of a flaming ſword, and again of a ſilver cord, ſtretch'd along the clouds, or like the irregular cracks of a phial from top to bottom; about eight next morning they had thunder, with a continuation of lightning ſuch as was above-mention'd, all from the N. E. or thereabouts, about nine the ſame morning, there fell down from the clouds, which look'd diſmally black, louring, and as it were heavy with rain, in the ſaid N. E. quarter, three water-ſpouts; that in the middle, ſeem'd to be as big, as the maſt of a ſhip, and the Dr. judged it to be diſtant at leaſt a league and

and a half; the other two were not half ſo big; all of them were black, like the cloud from which they fell, and ſmooth without any irregularity; only that at firſt falling, ſome fell perpendicularly, others obliquely, and all of them were ſmaller at the lower than at the upper end, repreſenting a ſword; ſometimes alſo, one of them would bend, and become ſtreight again, and ſometimes become narrower, and again increaſe its bulk; ſometimes it would diſappear, and immediately fall down again; at other times it would be extenuated to the ſmallneſs of a rope, and again become large as before: There was always a great boiling up of the ſea, as in a *Jette d'eau*, or water-work; and this riſing of the water had the appearance of a chimney ſmoaking in a calm day; ſome yards above the ſurface of the ſea, the water ſtood like a pillar, and then ſpreading itſelf, it was diſſipated like ſmoke; and the ſword-like ſpout from the clouds, either came down to the very middle of this pillar, as if it had been join'd to it, as the largeſt pillar, which fell perpendicularly down, always did from the beginning to the end; or elſe it pointed to this column of water, at ſome diſtance, either in a perpendicular, or oblique line, as did the other two leſſer ones: There were three or four ſpouts more, which appeared at the ſame time in the ſame quarter of the heavens, but not like the three former, either in bulk or duration; thoſe laſt appear'd and diſappear'd ſeveral times, during the continuance of theſe three aforeſaid; it was hardly diſtinguiſhable, whether the ſword-like ſpout firſt fell down from the cloud, or whether the pillar of water firſt roſe from the ſea; both appearing oppoſite to each other all of a ſudden; only the Dr. obſerv'd of one of them, that the water boil'd up from the ſea to a great height, without the leaſt appearance of a ſpout pointing thereto, either perpendicularly, or obliquely; and here the water of the ſea never came together in the form of a pillar, but roſe up in a ſpreading manner, the ſea boiling round the place; the wind being then N. E. the ſaid boiling advanc'd towards the S. W. as a flitting or moving buſh upon the ſurface of the ſea, and at laſt it ceaſed; this ſhews that the boiling, or flying up of the water of the ſea may begin before the ſpout from the cloud appears; and indeed, if there is any ſmall matter of priority betwixt theſe two appearances, the boiling, or throwing up of the ſea has it; which firſt begins to boil, and then forms itſelf into a pillar of water, eſpecially on the lower part thereof: It was obſervable of all of them, but chiefly of the large pillar, that towards the

the extremity it began to appear like a hollow canal, only black in the borders, but white in the middle; and tho' at firſt it was altogether black and opaque, yet one could diſtinctly perceive the ſea-water fly up along the middle of this canal, as ſmoke does up a chimney, and that with very great ſwiftneſs, and a very perceptable motion; and then ſoon after the ſpout, or canal burſt in the middle, and diſappear'd by little and little; the boiling up and the pillar like form of the ſea-water continuing always the laſt, even for ſome conſiderable time after the ſpout diſappear'd, and perhaps, till the ſpout appear'd again, which it commonly did in the ſame place, as before, burſting, and forming itſelf again ſeveral times in a quarter, or half an hour.

The Dr. ſuppoſes that this phænomenon may be ſolv'd by ſuction, or rather pulſion, as in the application of a cupping-glaſs to the fleſh, after the air is firſt exhauſted by the kindled flax: It was further obſervable, that the oblique ſpouts always pointed from the wind; that is, when the wind was at N. E, the oblique ſpouts always pointed to the S. W; tho' at the ſame time there were others perpendicular, which ſtill continued ſo, notwithſtanding the wind; as alſo, that ſuch as were curv'd, had ſtill the convex ſide from the wind, and the concave ſide towards it; that is, the wind being at N. E. the concave was towards the N. E, and the convex towards the S. W. It rain'd a great deal during the continuance of theſe ſpouts, and after their total diſappearing, there was half an hour's violent ſtorm from the N. E. with very little rain; and after that the weather clear'd up.

Plate III. Fig. 2. A the ſpout of a black colour, falling perpendicularly from a black cloud; B the water of the ſea, riſing in the form of a pillar or column in the middle, and ſcatter'd round the ſaid pillar, like ſmoke, or rather like the falling of a *Jette d'eau*; theſe two met each other directly, and the column of water from the ſea is commonly groſſer than the ſpout from the clouds.

Fig. 3. A a curved ſpout, joining with the riſing water of the ſea at B.

Fig. 4. A repreſents a black ſpout, falling obliquely from the clouds of the ſame colour; B the aſcending column of the ſea-water as in Fig. 2. with this difference, that borh the ſpout and column of water did not meet.

Fig. 5, E and W repreſent eaſt and weſt; 1, 2, 3, the ſucceſſive progreſs of the boiling of the ſea from eaſt to weſt, or from

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Fig. 6. A repreſents the large perpendicular ſpout, a little before its burſting, white in the middle; B the column of ſea-water joining therewith, 2, 2, 2, 2, the water of the ſea, aſcending in the form of ſmoke up a chimney, all along the column at B up to the clouds.

Fig. 7. A, the burſting of a perpendicular ſpout, commonly beginning in the middle at *a*; B the riſing of the ſea-water, begins to ceaſe, and the middle column to diſappear.

Fig. 8. A, an oblique ſpout, which after reaching the ſea in a curved line, or obtuſe angle, does ſoon after burſt at *a* and diſappears; B the riſing of the ſea-water alſo beginning to ceaſe.

Fig. 9. A, a perpendicular ſpout beginning to fall; B the water of the ſea under it beginning to aſcend.

Fig. 10. A, an oblique ſpout beginning, or darting itſelf out of the clouds; B the riſing, or boiling of the water, anſwering to it in an oblique line; theſe ſometimes reach down to the ſea, or riſing water, and ſometimes they do not reach thither, but continue a while, as here repreſented.

The Way of catching Fowl *and* Deer *in* Ceylan, *&c. by Mr.* Strachan. Phil. Tranſ. N° 278. p. 1094.

THE method they uſe in catching water-fowl is this; in loughs and waters, which are not very deep, the fowler puts an earthen pot upon his head, in which pot there are holes bored, thro' which he may ſee; then he wades into the water, nothing being ſeen but the pot, and thus he enters into the midſt of all the fowl, they, taking it to be a floating block, or ſome ſuch thing, take no notice of it, tho' it be cloſe by them; then the fowler takes hold of one by the leg, and pulling him under water, wrings his neck about; the reſt of the fowls, not perceiving this, ſit ſtill; then he goes to the next, and does the ſame, and ſo on, till he catches as many as he pleaſes; ſuch as have guns, make a frame, which they cover with green branches, ſo broad as to cover their whole bodies, they ſtand behind it, then the fowler carrying the frame before him, the fowl or deer ſeeing nothing but the green branches, is not affrighted; and thus advancing near enough, he fires; it is ſurpriſing how ſome beaſts are affrighted with fire, as lyons, tigers, wild ſwine, *&c.* and as the *Ceylaneſe* chaſe the elephants, wild ſwine, and tygers from their plantations by fire, and the natives at the *Cape of*

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Good Hope chaſe the lyons from their cattle; ſo the *Ceylaneſe* catch harts, deers, elks, and hares, which they perform thus; two men go in the night time into the wood; one of theſe takes an earthen veſſel upon his head, wherein is a fire burning, made of ſticks, and a kind of roſin; and in one hand he carries a ſtaff, on which are faſtened eight bells, the more harmonious they are ſo much the better; the other man goes behind with a ſpear in his hand; whenever the deer perceives the light, and hears the bells, he draws near, ſtanding amazed, for he does not ſee the men; in the mean time, the man with the ſpear penetrates thro' his body, and catches him.

There are two ſorts of ſerpents, which are thought not to be venomous, and which a *Ceylaneſe* will not kill; the firſt, is of a blueiſh colour, and frequently comes into their houſes in queſt of rats only, which he eats; he creeps into their neſts, and deſtroys them all; this ſerpent is an inch and a half thick in diameter, and about two yards and a half long; the other is green like the leaf of a tree, on which it winds itſelf, climbs up the trees, and catches birds; lying ſtill, as if it had no motion, till it ſees a fit opportunity to catch its prey; this is about half an inch in diameter, and a yard long: The *Talgoi*, or ant-bear, will lie down, as if he was dead, by the little neſts which are built by theſe ants called *Waia*, lolling his tongue out as far as he can; the ants will immediately fix themſelves in great numbers upon its tongue, then drawing his tongue in, he ſwallows them; and then he ſhoots forth his tongue again, continuing ſo to do, till he has ſatisfied his hunger: There are two ſorts of cinnamon-trees, of which the beſt has a leaf much larger and thicker than the other; but no other perceivable difference; if the leaves of both ſorts are diſtilled, they yield oil and phlegm, as if cloves had been put into the ſtill; upon the root of the tree there is a thick bark, which, when diſtilled, as the former, yields both oil and camphire, which are ſeparated, by covering the receiver with a linen cloth, and the camphire will remain in a lump together in the cloth, and the oil and phlegm will run into the receiver; this camphire has the ſame colour, the ſame diſcuſſing, diſſolving, healing, and balſamic quality with the camphire of *Japan*; the oil has the like virtue; for anointing ſcabs, itch, and excoriations therewith, it cures them in a ſhort time; drinking the phlegm mixed with common water cures fluxes, and does ſervice to ſuch as are under that languiſhing diſorder, called by the *Dutch* the *Land's Diſeaſe*, and by the *Ceylaneſe*, *Pipa*: Mr. *Strachan* never ſaw the natives uſe cinnamon, tho' they

ſcarcely

ſcarcely have a meal without pepper; nor is it uſed by the *Europeans* either in meat, or diſtill'd among arrack, or infuſed in their drink; for, it is thought to occaſion ſhortneſs of breath; whether this be the cauſe of it, or whether the *Ceylaneſe* are afraid to bring it to particular perſons, ſeeing the *Dutch* have ſevere laws againſt ſelling it, he cannot tell.

Parhelia *and* Circular Arches *in the Air*; *by Mr.* Halley. Phil. Tranſ. N° 278. p. 1127.

ON the 8th of *April* 1702, about 10 o'clock in the morning, the air being clear, Mr. *Halley* obſerved, whilſt the ſun ſhone but faintly, or appeared wateriſh, ſeveral arches of circles round him, as is repreſented Plate III. Fig. 11. whereof S is the true ſun; Z the *Zenith*; STPP a large white circle paſſing thro' the ſun, parallel to the horizon; it was very diſtinct and entire, about two degrees broad in the northern part about T; it had much the ſame breadth in the eaſt and weſt, but grew narrower towards the ſun; its edges were not very well defined, the whole appearing like a faint white cloud, and a part thereof would have been taken for ſuch; but the whole circle ſeen in the pure azure ſky was very extraordinary; VNXY a halo, or rather iris, that was alſo an entire circle, having the ſun for its centre; Mr. *Halley* computed its ſemi-diameter to be much about 22 degrees; the breadth of this arch, which was well defined, was by eſtimation equal to the ſun's diameter, and it was coloured with the colours of the iris, but nothing near ſo vivid, as in the common rainbow; the red colours were next the ſun, and the blue in the outer limb; within this circle the ſky appeared ſomewhat obſcure, eſpecially near the arch; and Mr. *Halley* ſuppoſed that the cauſe of that obſcurity, was likewiſe, that which made the ſun ſhine ſo faint and wateriſh; PUP is an arch of another circle, of which only the upper part appeared, it was in all reſpects, both for breadth and colours like the circle VNXY, which it touched in the vertical point V, but its centre was below at N, or near it; in the interſections of this arch with the white circle on both ſides, there were two very bright *Parhelia*, which were alſo tinged with colours, eſpecially on the ſide next the ſun, where they were very red; having meaſured their diſtance from the true ſun, he found it 31 degrees and a half; about V, where the two arches were co-incident, it was alſo very bright, and the red on the inſide was very ſtrong; but the ſpecies of the ſun was there ſo drawn out in length, that it could not properly be called a *Parhelion*;

this arch PVP broke off on both ſides, about five or ſix degrees below the *Parhelia* PP. At N, or the lower part of the circle UNXY, there alſo appear'd a ſmall piece of an arch, which touch'd it in the ſame manner as PUP did in V; it ſeem'd to have its centre in V; and about N there appear'd another longiſh red ſpecies, ſuch as at V, but not altogether ſo bright.

The height of the ſun, during the obſervation, was from 40 to 45 degrees, when by the interpoſition of clouds, there was no more to be ſeen; the weather was cooler than ordinary, with a gentle north-weſt wind; and it was plain, that the vapour which cauſed this appearance, was higher than the clouds, for they were ſeen to drive under the circles.

Roman Inſcriptions *and other* Antiquities *in* Yorkſhire; *by Mr.* Hunter. Phil. Tranſ. N° 278. p. 1129.

THERE was a *Roman* ſtation in the county of *Durham*, at a village called *Ebcheſter*; it was ſurrounded with a wall of hewn ſtone, and ſeems to have been an exact ſquare of about 200 yards on every ſide; there have been ſuburbs here towards the weſt, ſouth, and perhaps eaſt, of a conſiderable extent; but towards the north the wall ſtood upon the top of a ſteep bank, under which runs the river *Derwent*, in which was found a long altar, but its inſcription was defaced; as alſo a leſſer ſtone, with this word HAVE on one ſide; there is another, which is uſed as a grave-ſtone, that lies before the church-door, which ſeems to have been *Roman*, by the engraving of a man from the breaſt upwards in a *Roman* dreſs; in the ruins of this place, ſeveral inſcriptions have been dug up by the inhabitants, and in moſt places, they could plainly diſcern two different foundations of ruin'd houſes; and moſt of the ſtones thus dug up were tinged with a deep red colour, undoubtedly, by fire; that part of the village, which ſtands within the walls, is called the *Main*, where are moſt of the ruins; there are alſo ſeveral tiles of a red clay dug up, but not one of them entire: Upon undermining an old foundation ſtill viſible on a hill-ſide, there was found a conſiderable quantity of pewter: *Watling-ſtreet* paſſes by this place about 100 yards to the weſt, which could not conveniently be brought thro' the town, by reaſon of a brook 2 or 300 yards to the ſouth, whoſe banks are very uneven; and the above-mention'd ſteep hill, towards the north, makes a paſſage that way next to impoſſible; Mr. *Hunter* could meet with no certainty whether the *Romans* ever laid a bridge over *Derwent* at *Ebcheſter*, but he thinks it probable they had, both from the num-

ber

ber of ſoldiers, which muſt needs paſs that way, as alſo from the conſiderable largeneſs of this river.

From the following paſſage in the ſecond book of *Ptolemy's* Geography, *ſub Elgovis & Olludinis ad utraque maria habitant Brigantes, in quibus Urbes Epiacum, Vinnovium, Caturadonium, Calatum, Iſurium, Rhigodunum, Olicana, Eboracum*, &c. Mr. *Hunter* ſuppoſes, that this might probably have been the *Epiacum* of the *Romans*, eſpecially, if it be granted, that this author mentions only the places in the eaſtern parts of this province; but, if *Epiacum* be placed at *Papcaſtle*, and *Rhigodunum* at *Ribcheſter*, then it will thwart this aſſertion; and indeed, Mr. *Hunter* is apt to think that *Ptolemy* begins his enumeration of the places amongſt the *Brigantes*, at the place neareſt *Adrian's* wall; and has advanced in order, tho' with ſome omiſſions to *York*, the chief town in the province; and further, the modern name *Ebcheſter* agrees with *Epiacum*, as well as *Papcaſtle* does; for, the mutation of P into B is uſual.

Moſt of the words in the *Roman* inſcriptions Mr. *Hunter* ſaw, were ſo artificially eraſed, that he is apt to think, they were thus defaced upon ſome revolution in the *Roman* government; theſe ſtones, with ſeveral more, beautified with inſcriptions and ſculpture, were dug up in a field called the *Bower*, about half way between the *Roman* wall and ſouth *Tine*, and near two miles weſt from *Buſie-gap*; and here was kept a *Roman* garriſon; it was ſurrounded with a ſingle wall, and was ſquare, but now it is nothing but heaps of ſtones, overgrown with buſhes; on the weſt-ſide of this place, about 50 yards from the walls thereof, there was diſcovered under a heap of rubbiſh, a ſquare room ſtrongly arched a-top, and paved with large ſquare ſtones ſet in lime; and under this a lower room, whoſe roof was ſupported by rows of ſquare pillars, about half a yard high; the upper room had two niches, like, and perhaps, in the nature of chimneys on each ſide of every corner, or ſquare, which in all made 16; the pavement of this room, as alſo its roof, were tinged black with ſmoke; the ſtones uſed in arching the upper room were marked, as joiners do deal-boards for chambers; thoſe Mr. *Hunter* ſaw, were number'd x. xi. xiii. there was found, in this ground, a winged image, that was about three inches long, but wanted the head and feet; the other inſcriptions were all found near the *Houſe-ſteads*, a place ſo call'd from the abundance of ruins there, about half a mile from *Buſie-gap* towards the weſt, and juſt within the *Roman* wall; among the ruins were found ſeveral pedeſtals, two or three pillars, and two images, but ſomewhat defaced.

Mr.

Mr. *Hunter* found *Watling-ſtreet* very viſible from near *Eb-cheſter*, almoſt to *Corbridge*, which is about ſeven miles; Mr. *Hunter* travelled upon this ſtreet almoſt to *Reſingham*; and it is very viſible all the way; about a mile ſouth from *Reſing-ham*, there is a pillar about eight foot long, which ſtood by the way-ſide, but is now fallen; a braſs-medal was found here, the Emperor's name was worn off, only AUG. PIUS was very legible; and by the figures of other medals, he took it to be one of *Antoninus*'s, on the reverſe was a wolf, without any inſcription; the next *Roman* town he viſited, was *Rocheſter*; ſome part of the way *Watling-ſtreet* was very viſible; tho' this was not the largeſt, yet Mr. *Hunter* ſuppoſes, it has been one of the beſt fortified places the *Romans* have been maſters of in the north; and indeed, it was neceſſary it ſhould be ſo, ſince it was not only a frontier town, but was ſurrounded with enemies; from this place he returned to the *Roman* wall at *Carrow*, between which, and *Walwich*, the wall has been repaired, and fronted with its old ſtones again.

The Planting *and* Culture *of* Tobacco *in* Ceylan; *by Mr.* Strachan. Phil. Tranſ. N° 279. p. 1134.

THERE are here two ſorts of tobacco, both which are called *Dunkol*, *i. e.* a ſmoaking leaf; the one is *Hingele Dunkol*, or *Singele Dunkol*, the other is *Dunkol Kapada*, which laſt is very intoxicating, and much ſtronger than the former; they are both of the ſame ſpecies, and the only difference is that *Singeleſe* tobacco requires but little culture, whilſt a great deal of pains is taken upon the other, till it is fit for uſe; and it is done after the following manner; the natives clear a little piece of ground, in which they ſow the ſeed of tobacco, as gardiners do parſley and coleworts; againſt the time that this is ready for tranſplanting, they chuſe a piece of ground, which they hedge about; when the buffelo's begin to chew the cud, they are put into this hedged ground, where they continue day and night, till it is ſufficiently dung'd; and then it is turned up with a ſpade, in form of a pick-ax, ſuch as carpenters dubb planks withal, by houghing the ground, and mixing the manure with the ſoil; when the ground is made ſmooth, they remove the plants out of the bed wherein they were ſown, and ſet them here, about a foot diſtant from each other, and then they grow up almoſt like a dock; when the ſtem has got 15 leaves, they cut off all the tops; and if they do not deſire to have the tobacco very ſtrong, they let it grow, till it has 18 or 20; but, when they would have

have it ſtrong, they top it when it has got 10 or 12 leaves, not reckoning the three or four which are neareſt the ground, becauſe, they never grow ſo big, nor ſo good as thoſe above them; thus, the moiſture of the ground not being waſted in leaves, flowers, and ſeed, it makes the remaining leaves four or five times larger, fatter, fuller of ſtrength and virtue, than the tobacco which is not order'd after this manner; now, the moiſture aſcending from the root, being confin'd within the compaſs of theſe leaves, forces its way between the ſtem, and remaining leaves, emits young ſhoots, and would grow forth in branches, if no care was taken to hinder it; therefore, every third or fourth day they go thro' all the ſtems, and break off their buds; and this they continue to do, till the leaves are ripe, (which takes up as much time as the *Singeleſe* tobacco, which has flowers and ripe ſeed, and then begins to wither and ſpoil, if no uſe is made of it) which is known by their firmneſs and thickneſs; then, whilſt the leaf is green, before it begins to wither, the natives cut down the ſtem together with the leaves, and carrying them home, they lay them in a heap; and thus, the leaves will begin to ferment, turn hot, and ſweat; and when they begin to ſweat, they turn the inſide out, that they may ferment eaſily, otherwiſe the innermoſt would ferment too much, ſpoil, and rot; thus, the longer they lie in a heap together, the tobacco turns darker colour'd; when they think it has ſweated enough, they hang it aſunder upon cords, till the leaves are dry; then they ſeparate the leaves from the ſtalks, and lay them up in bundles till they have occaſion for them.

The other tobacco called *Singele Dunkol* is only ſown, and then tranſplanted, having liberty to grow, ſhoot out into flower, and ſeed, which ripen altogether; then it is cut down, and thrown together in a heap; ſome will ferment too much, and rot; others will not ferment at all, and continue green, tho' dry, and ſmell like hay or dry graſs; ſome of the ſoldiers, that love to ſmoke a large pipe full, and often uſe this common ſort, will mix ſome of the *Kapada* amongſt it; the *Cingualeſes*, who do not ſmoke ſo much at once, nor ſo frequently, take a piece of the *Kapada*, and roll it together, then roll a piece of dry leaf of the *Wattukan*-tree about it; they kindle it at one end, and ſuck at the other, till it is conſumed; ſome again chew it amongſt *Betle*, taking but very little at once.

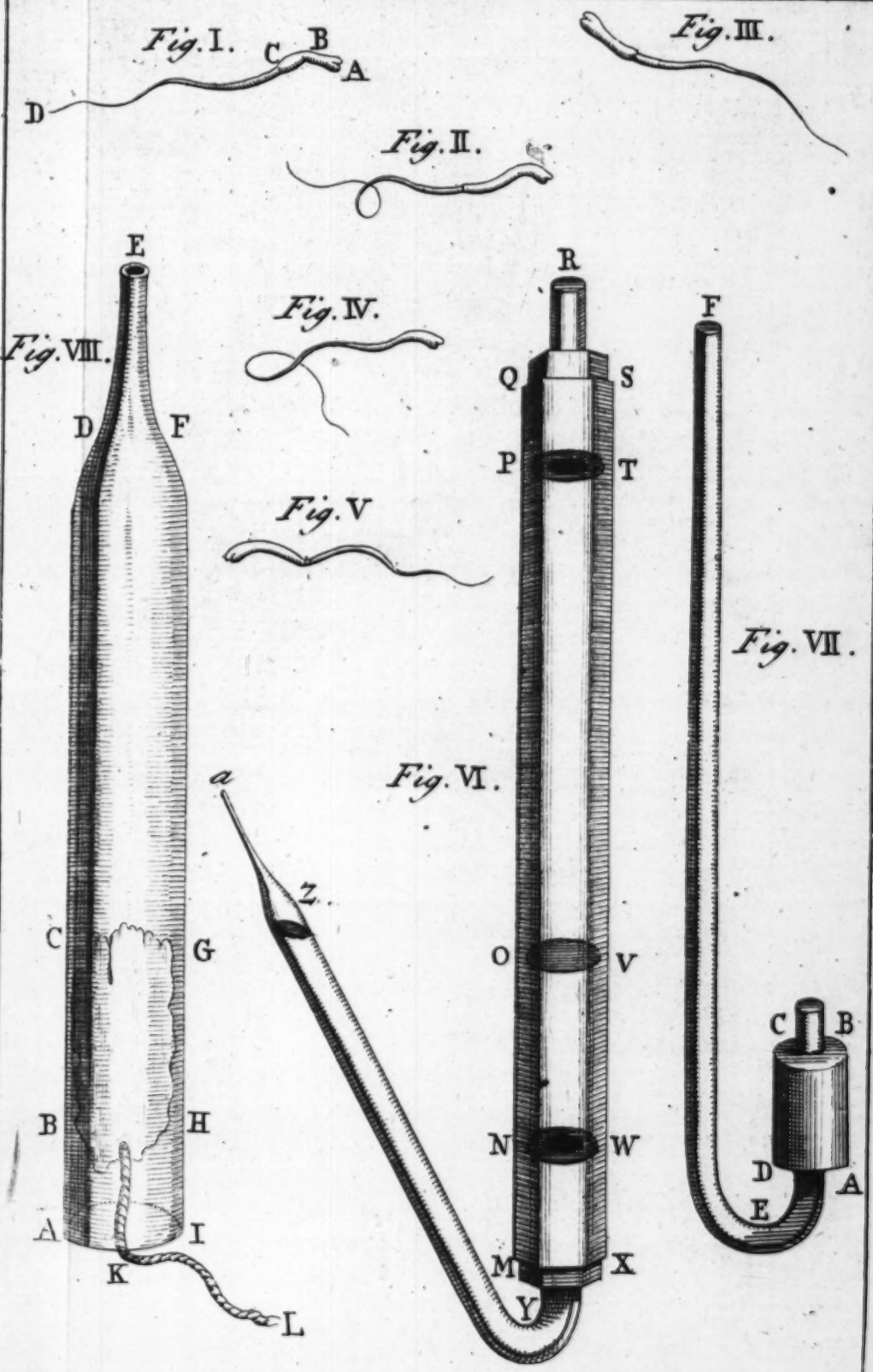
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The Animalcula *in* Semine maſculino *of* Cocks *and* Spiders, *Shortneſs of* Breath, *&c. by M.* Leewenhoeck. Phil. Tranſ. N° 279. p. 1137.

M. *Leewenhoeck* had often obſerv'd, that young cocks that were not arriv'd to half their growth, were wont to tread the young hens to couple with them, which the latter always refuſed till they had laid eggs, that is, till they were three or four months old; this made M. *Leewenhoeck* conclude, that when the young cocks were thus ſtimulated to copulation, the *Animalcula* in their ſeed were living, which upon viewing, he always found to be ſo; having opened the ſeminal veſſels of a young cock that was newly killed, pluck'd, and ſtill warm, he alſo diſcover'd theſe *Animalcula* living, and they continued alive for half an hour, after he had ſqueez'd a drop of the ſeed out of the ſaid veſſels; theſe *Animalcula* appear, both when they move and when they lie ſtill, as if the fore-part of their bodies were crooked, or circular. Plate IV. Fig. 1. A B C D repreſents one of thoſe *Animalcula* in its full length, whereof A B C is the body, which ſeldom is quite ſtreight, but the tail is for the moſt part folded; C D ſhews its tail, which is long, and exceeding ſmall; in the fore-part of the bodies of ſeveral of thoſe *Animalcula*, M. *Leewenhoeck* diſcovered a bright ſpot, which was plain to be ſeen in others; and the tails of ſuch as lay dead were like ſo many bows, as repreſented Fig. 2, 3, 4, 5; from hence he ſuppoſed, that the *Animalcula in Semine maſculino* of other animals are alſo provided with long tails; on the 17th of *September*, about 10 o'clock in the morning, he again viewed the *Semen* of a young cock, which was judged to be about 12 weeks old, and had been killed an hour before, wherein he found the *Animalcula* alive; he took ſome of the ſame ſeed, about the quantity of a pin's head, ordering it in ſuch a manner, that very little of the fluid matter could exhale; he obſerved it every hour, and about 7 o'clock the ſame evening, he found the *Animalcula* as lively, as if they proceeded from a cock newly killed; but about 8 or 9 o'clock, he could perceive ſeveral of them dead, and in one place, which was no larger than a grain of ſand, there were great numbers of them ſtill living; but a little further, and in a place of much the ſame extent, he could not perceive the leaſt motion in ſuch as lay there; the 18th of *September*, about 7 o'clock in the morning, and alſo about noon, M. *Leewenhoeck* again made his obſervation of the ſame *Semen*, as it lay in a glaſs-tube, as large as a thick pin, but he could diſcover no


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PLATE. IV.


Fig. I.
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Fig. III.
Fig. II.
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Fig. IV.
Fig. VIII.
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Fig. V
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Fig. VII.
Fig. VI.
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in the *Animalcula*; but, when he look'd upon another part of the ſame matter, of the bigneſs of a large grain of ſand, and ſpread very thin upon the glaſs, he ſaw ſeveral very lively and nimble in their motions, but their life and motion dwindled away, till at laſt he could perceive none; the reaſon of which M. *Leewenhoeck* judged to be, that all the thin fluid matter was exhaled from the ſeed, and that then the *Animalcula* preſently die; in order to be further ſatisfied in this matter, he took a dead cock, that had been kill'd and pluck'd the day before, between the hours of 7 and 9 in the morning, and opening the body, he pull'd out the guts and ſtomach, the better to come at the *Vaſa Deferentia*; out of one of which he ſqueezed a drop of the ſeed, and putting it directly before his microſcope, he could ſee a vaſt number of thoſe *Animalcula*, ſwiming in legions together, and croſſing each other like clouds in a ſtormy day, and as briſk and lively, as if the cock had been newly killed; M. *Leewenhoeck* put into the body again, that part of the intrails he had taken out, and drew the ſkin over it, in order to take out a little more of the ſeed about ſix hours after; and accordingly having taken out a little about noon, he found the *Animalcula* therein ſtill living; but in the evening about ſix, having again taken ſome of the *Semen* out of the *Vaſa Deferentia*, he could not perceive any of them living; then, he open'd thoſe veſſels in ſeveral places, even where they terminated in the teſticles, but the *Animalcula* were all dead: Seeing that the *Animalcula in Semine maſculino* are alive when taken out of the cock's body, and ſo long after the cock itſelf is dead; it is probable, they are deſigned to faſten in the hen's *Ovarium*, or egg-neſt, and impregnate not only one, but the ſeveral yolks, which compoſe the bed of eggs; the rather becauſe we find, that by one coition of the cock and hen, moſt of the eggs, the hen lays in a month or two after, are impregnated; M. *Leewenhoeck* has often thought, whether or not, each of the yolks in the *Ovarium*, which have not arrived to the hundredth part of their growth, are not deſigned to receive one of thoſe *Animalcula* from the ſeed of the cock, and keep it there, till the yolk is ſurrounded with the white, and the neceſſary heat introduced; the rather becauſe, we know that from the white the chick receives its firſt growth.

A certain gentleman, that had often conſider'd the nature of ſpiders, and their copulation, told M. *Leewenhoeck* that he could ſeldom meet with the males of the large ſpiders, and that he believed the females killed and eat them up; and M. *Lee-*

wenhoeck was further told by the ſame gentleman, that where the females of the ſmaller ſort of ſpiders were ſeen, there was alſo one male, which M. *Leewenhoeck* accordingly obſerved: M. *Leewenhoeck* having often been in places, where thiſtles, nettles, and other weeds grow, he ſaw ſeveral ſorts of ſpiders, and in great numbers; and he obſerv'd, that when the male ſpiders approached the females, in order, as he thought, to copulation, the females always put them to flight; he took up, ſeveral times, the male ſpiders, and was fully ſatisfied that that little white matter, he had often ſqueez'd out of the hinder part of their bodies, and which was ſometimes as big as a grain of ſand, and ſometimes a little bigger, was nothing elſe but the male ſeed of theſe animals; he diſcovered therein a vaſt number of *Animalcula*, which continued living a pretty while; they were ſo exceeding ſmall, that M. *Leewenhoeck* ſuppoſes, that 1,000,000,000 of their bodies joined together, would not be equal to a barley-corn in bigneſs; by reaſon of the exceeding ſmallneſs of theſe *Animalcula*, M. *Leewenhoeck* could not poſſibly repreſent the exact figure of their bodies, nor of the inſtruments wherewith they mov'd ſo ſtrongly, as to continue living above five hours, after they were ſeparated from the ſpiders; he had 10 or 12 other male ſpiders, in which he could diſcover no new *Phænomena*; ſo that he took it for granted, that their *Membrum virile* is in the hinder part of the body, tho' he never ſaw an actual copulation; in theſe laſt ſpiders, M. *Leewenhoeck* could perceive no ſeed at all; which he attributed to one or other of theſe reaſons; either the male ſeed was not yet ripe enough in them, or, it may be, they had lately coupled before he catch'd them; it ſometimes happened, that by preſſing out the ſeed, their *Fæces* were mixed with it; he ſhut up in a glaſs-tube three males and one female together; and after the ſpace of two days, he ſaw the female fall upon the males with ſuch violence, that the blood ran out of their feet; upon which M. *Leewenhoeck* killed the female, and next day he ſaw two of the males lie dead, and the remaining male was eagerly devouring the female; he had ſhut up in the glaſs-tube for 48 hours three other male ſpiders, and having hinder'd them all that time from copulation, he found ſeed enough in each of them; and he obſerv'd the *Animalcula* therein alive.

M. *Leewenhoeck* was perſuaded of the truth of this poſition, that in caſes of ſhortneſs of breath, it was impoſſible to find any vehicle that could inſinuate balſams effectually into the lungs,

lungs, and that it was in vain to anoint the breaſt and ſtomach therewith, as what could never reach the lungs; and that the ſcent of the balſam, which exhaled from ſuch as uſed to anoint their breaſts with oil, did not evaporate from the pipes of the lungs, but from the breaſt by the neck; becauſe he was convinc'd, that nothing that is in the ſtomach, or bowels can be convey'd to the lungs, unleſs it has firſt paſs'd thro' the heart; and conſequently much leſs can balſams, wherewith we anoint our breaſts, find any paſſage into the lungs: The only means M. *Leewenhoeck* could think of, to inſinuate the inviſible particles of balſam into the lungs, was to take a piece of ſilver or copper, of the bigneſs of a ſhilling, and making a little hole therein, to fill the cavity with ſome balſam, proper for the lungs of one affected with a ſhortneſs of breath, and after that let the patient put it upon his tongue, and ſtopping his noſtrils, let him receive no air into his lungs, but by his mouth; by which means the ſubtile particles of the balſam, which M. *Leewenhoeck* calls its ſpirits, may exhale and deſcend into the pipes of the lungs.

Further M. *Leewenhoeck* took a tube MNOP Plate IV. Fig. 6, which was 15 inches long, and about an inch in diameter, of an equal ſize throughout; he ſtop'd it at each end with a cork, as at MNWX, and PQST; in the uppermoſt cork PQST, he made a little round hole quite through, wherein he ſtrongly inſinuated a ſmall glaſs-tube R, that not only no water, but even no air could enter therein; and in like manner he perforated the other cork MNWX; having done this, he thruſt into the lowermoſt cork, another long crooked glaſs-tube YZ, which tapered into a ſmall end as Z*a*; on purpoſe, that the air, when ſuck'd in at R, might enter leiſurely at the ſtreight paſſage Z*a*; in order to try how it might ſucceed, he drew the cork PQST out of the tube, and pour'd a little brandy into it, as in NOVW, and having then plac'd the ſaid cork with the ſmall tube therein, into the large tube again, and putting the ſmall tube R between his lips, and ſucking in the air, which ruſh'd in at the ſmall end *a* of the tube YZ, and which was made to paſs thro' the brandy, he perceiv'd the brandy to be put into a violent agitation and bubbling, and the ſpirits thereof made to riſe in an extraordinary manner up into the mouth, and conſequently into the lungs, as the event plainly demonſtrated: If then the exhalations, or volatile particles of balſam are rendred ſerviceable, not only for comforting, but likewiſe for curing weak diſtemper'd lungs,

the more of the ſpirits of theſe balſams can be conveyed into the lungs, ſo much the better it is for them; yet he would not have the air paſs ſo ſimply thro' the balſam, as through the brandy, when the tube ſhould be fill'd with the former to the ſame height as it was with the latter, but intended, ſo far as it was fill'd with balſam to put it into hot water; however, in order to prevent the burſting of the tube by too ſudden a heat, it ſhould be laid in a baſon fit for the purpoſe; with ſome cold water, pouring ſoftly a little boiling water thereon to the height of the balſam, or elſe to lay the tube in a baſon with the neceſſary quantity of water, and put it upon the fire; by this means the ſpirits of the balſam will exhale much more freely, than when it is cold, and the lungs will be heated in ſuch a manner thereby, as to put the patient into a gentle ſweat: M. *Leewenhoeck* often thought, that theſe balſams, or at leaſt ſome cordial gums, herbs, or juices, are not only good againſt ſhortneſs of breath, but do alſo preſerve the lungs from cold ſtinking miſts, and peſtilential air; and the beſt balſam for ſhortneſs of breath is that of *Peru*: M. *Leewenhoeck* prepared ſuch a tube, as is repreſented by Fig. 7. A B C D E F, which was longer than that by Y Z *a* in Fig. 6. for this reaſon, that if a perſon had a mind to put more balſams, or juices into the tube, this long pipe might be thruſt up higher into the water.

Now if we conſider the ſtructure of our bodies, as far as they are known to us, we may firmly conclude that no part of us is expos'd to ſo many diſorders, as the lungs; for, how eaſily may they be hurt, if we do but go into the cold air, which ingenders, and cauſes us to diſcharge phlegm, to cough and ſpit; and how eaſily are the globules of blood in the fine veſſels of the lungs coagulated by the cold.

In order to get further light into theſe matters, M. *Leewenhoeck* view'd with a microſcope the ſmalleſt parts of the lungs of two ſeveral ſheep; and therein he diſcover'd that the air-veſſels were fill'd with purulent matter, even at the extremity or ſmalleſt part of the lungs; a butcher coming to view the lungs, he felt them in ſeveral places, and ſhew'd M. *Leewenhoeck* ſome hard parts about the length and breadth of two fingers; and he told him that that ſheep had catch'd cold, which had occaſion'd that diſtemper in its lungs; and upon M. *Leewenhoeck*'s aſking whether the ſheep would not have died of that diſorder, he was anſwerd that thoſe hard parts do often diſappear: M. *Leewenhoeck* could not diſcover the leaſt

puru-

purulent matter in the air-veſſels of the lungs of two other ſheep, which were of an agreeable colour, and like the other: Having view'd the outſide of the lungs of a ſheep that had no diſtemper, it ſeem'd to him that a great many ſmall tranſparent globules lay under the membrane; but, upon ſeparating the membrane from the liver, theſe tranſparent globules appear'd to be nothing elſe than little particles of air compreſſed together into various and irregular figures; and theſe globules ſeem'd to lie out of the air-veſſels: M. *Leewenhoeck* took ſeveral pieces of the lungs, and preſſing the blood out of the veſſels in which it lay, he found that a vaſt number of bubbles of air proceeded from thoſe veſſels; ſome of which were ſo exceeding ſmall, that they even eſcaped his microſcopes; thoſe globules M. *Leewenhoeck* ſuppoſed to be contain'd in very fine veſſels; and when the blood and air were ſqueez'd out of that part of the lungs, where there were no large veſſels, the remaining ones, whoſe tunics were exceeding fine, did together compoſe but a very ſmall portion of matter: Moreover, he took the unſound lungs of two other ſheep, and in handling them, he found that their parts were much harder than others, that were not diſtemper'd; and that the purulent matter was tougher, or thicker in thoſe lungs, than in the above-mentioned; and looking on the external parts of theſe lungs, he perceiv'd, in ſeveral places thereof, pellucid particles, which far exceeded in bigneſs the globules of air before ſpoken of; theſe clear particles were in ſome places of a greyiſh colour; but in others ſomewhat darker; M. *Leewenhoeck* having taken the laſt mention'd particles out of the lungs, they ſeem'd to be nothing but a hard ſubſtance, and the rather, becauſe upon ſeparating them, he could ſee no air-globules amongſt them; whereas in ſound lungs, how ſmall ſoever the pieces thereof were, he could eaſily diſcover, that, excepting the veins, they conſiſted moſtly of air-globules, which were not ſhut up within the veins; now, if the ſaid tranſparent particles were not in ſound lungs, M. *Leewenhoeck* would conclude that all of them would turn to a thin matter, in order to be thrown off the lungs by the ſheep, if it ſhould recover its former health; if we look upon ſound lungs, we would be apt to affirm that thoſe alſo conſiſted of ſuch tranſparent particles; but upon a nearer view, M. *Leewenhoeck* found that that phænomenon was only occaſion'd by a multitude of blood-veſſels lying within the membrane of the lungs, and in ſeveral places ſeeming to divide the globules of air: M. *Leewenhoeck* being

being now perſuaded, that all the diſtempers in the lungs of ſheep are occaſion'd by the cold air they ſuck in, he aſk'd two butchers, whence they thought the diſeaſes in their lungs proceeded? And they made anſwer, that the ſheep running in the meadows at the latter end of autumn, and eating graſs, that was either actually frozen, or cover'd with cold dews, was the true reaſon their lungs were thus ſpoil'd; and that this ſometimes happen'd even in *May*; but M. *Leewenhoeck* for his part, would rather conclude that the frozen graſs does not hurt their lungs, but their ſtomachs; M. *Leewenhoeck* knowing that the butchers fetch'd abundance of ſheep from *Brabant*, and that they are driven every morning into the field, and folded every night; and on the contrary, that their own country ſheep were brought into the meadows in *May*, and left there till it ſnows and freezes; M. *Leewenhoeck* aſk'd the butchers, whether the *Brabant* ſheep had ſuch bad lungs as the latter; and was told, ſeldom, or never; from whence he was ſtill the better ſatisfied, that the diſtempers in the lungs of ſheep, and eſpecially of ſuch as lie in the fields in long cold nights, were occaſion'd by nothing elſe, but their ſucking in the cold air: Moreover, M. *Leewenhoeck* aſk'd, whether ſuch ſheep were fat, whilſt they were kept up, and whether they could diſtinguiſh which, while living, had bad lungs; to which they anſwer'd, that thoſe whoſe lungs were touch'd, did never increaſe in fat, after they were folded; and that within a fortnight's time, after they were penned up, and fed with beans in order to fatening, the diſtemper uſually diſcloſed itſelf; for they did nothing but cough, and therefore they always kill'd thoſe ſheep firſt. Now, if we allow that the cold air is ſo prejudicial to the lungs, we ought not to wonder if ſuch an inconvenience, as a cold ſhould come upon them; yea, M. *Leewenhoeck* is of opinion, that in a long cold winter, the lungs may be ſo much incommoded, that a great fit of ſickneſs, and even death itſelf may be the conſequence; if we do but conſider what a deal of phlegm a perſon diſcharges in a cold; and if it be greeniſh it is almoſt a purulent matter, which is diſcharged by the air veſſels of the lungs; and the diſorder may go ſo far, that a conſumption of the lungs may enſue.

M. *Leewenhoeck* took a fine piece of cambric, in which he put a ſmall quantity of ſtrong, and well pounded cinnamon, and tying it up, he plac'd it in a glaſs-tube, having faſten'd to the cambric a ſtring to pull it out by; then putting his mouth to the extremity of the tube, and drawing in his breath, he

ould plainly perceive the invisible exhaling particles of the innamon to descend into his lungs; we cannot say that this innamon, being thus deriv'd into the pipes of the lungs, does trengthen the heart, but rather the lungs, unless we affirm hat the one partakes of the advantages of the other.

On the 19th of *September* 1701, it rain'd a little while about noon; whereupon M. *Leewenhoeck* intercepted some of the water in a *China* bason, made as clean as possible; this water he put into a glass-tube, in order to try whether there were any *Animalcula* therein; he view'd this water several days together, and could discover abundance of small atoms of dust, or particles that were floating in the air, and consisting of exceeding small parts of burnt wood, or charcoal; wherein he perceiv'd the horizontal and ascending vessels, as also a very small piece of straw, and several blackish particles, which he imagin'd to be conglomerated atoms of smoke, proceeding from the coals which brewers and smiths use; and among these here was an odd phænomenon, made up of little round bubbles that were congeal'd together, like the little stars of snow in winter; but he could meet with no *Animulcula* till the 28th of *September*; at which time he discover'd exceeding small ones; that one while fasten'd themselves to the sides of the glass, and then swam in the water with a tremulous motion; these *Animalcula* were so very small, and the glass-tube so thick, that M. *Leewenhoeck* could hardly see them, and the more, because they were as pellucid as the glass itself; their bodies were twice as long as they were big, and both extremities were tapering or dwindled into a small point; from the 30th of *October* to the 14th he could find no *Animalcula* alive in the water, tho' he examin'd it very carefully; whereas M. *Leewenhoeck* us'd only to observe the upper part of the water in the glass-tube, now on the 15th he turned his speculations towards the bottom of the said tube, which was 4 inches long and ¼ an inch in diameter; and here he could perceive abundance of those *Animalcula*, some sitting on the sides of the glass, and others swimming in shoals together; for when one of them stirr'd, all the rest, that were near, moved also; not content with these observations (because it was possible that there had been water in the tube before, and that from thence these *Animalcula* might have proceeded) he took another tube that had lain dry near 20 years in a chest, and where he was well assur'd, that neither water, nor any other matter had been put, excepting air, and such atoms as are always floating therein; on the 18th

it

it rained in the morning, after which there had been very ſtormy weather for ſeveral days; he twice threw away the rain-water he intercepted in a *China* baſon, but the third time he put it into a glaſs-tube; M. *Leewenhoeck* view'd this laſt water ſeveral days; but notwithſtanding all the pains he took, he could not diſcover any thing that had life therein; tho' it is true, he ſaw ſeveral ſmall particles fix'd to the ſides of the glaſs, that came very near in figure, and ſize to the afore-mentioned *Animalcula*; yet on the 24th, he plainly diſcover'd three of them running on the glaſs, and ſwimming in the water, not in a ſtreight line, but in circles and windings; and next day he could perceive in ten different places ſome of the *Animalcula* running, and others ſwimming; and that as diſtinctly, as when we ſee with the naked eye thoſe *Animalcula* commonly call'd water-flies, ſwimming in ordinary brooks and canals; M. *Leewenhoeck* could now obſerve againſt the ſides of the glaſs, in the compaſs of a large grain of ſand, above an hundred particles that were of the ſize of the aforeſaid *Animalcula*; which particles he view'd ſeveral times, in order to ſee, if poſſible, whether they were living animals, or whether there were any thereabouts; but with all this circumſpection, he could diſcover nothing till the 28 of the ſaid month, at which time he perceived 25 *Animalcula* proceeding from the laſt mention'd particles, which ſwam and ran about the ſides of the glaſs; and then he alſo obſerv'd two ſorts of theſe *Animalcula*; the ſmalleſt ſort appear'd to him ſometimes ſhining, and ſometimes not, which appearance M. *Leewenhoeck* imagin'd might proceed from the light reflected from the ſmooth backs of theſe animals; and this laſt ſort had quite a different motion in ſwimming, from thoſe others which were ſomewhat bigger; in the remaining particles that ſtuck to the ſides of the tube, he could perceive no alteration; he further obſerv'd the ſaid water ſeveral days after, and he ſaw the ſmalleſt ſort of theſe *Animalcula* in vaſt numbers, wherever he caſt his eye, either ſwimming, or running about the ſides of the tube; and whereas M. *Leewenhoeck* held the tube full of water in his hand, and conſequently put the water in a gentle kind of motion, he could perceive that the ſtream would often be too ſtrong for theſe *Animalcula*, and carry them along with it; and the chiefeſt difference he could find between theſe *Animalcula*, and the inanimate particles which he alſo obſerv'd in the water, and which were very like the other, was that the former made ſmall angles in ſwimming; whereas, the latter always

lways mov'd in a ſtreight line: M. *Leewenhoeck* alſo obſerv'd, hat when he put water into a glaſs-tube that had never been etted, abundance of air-bubbles appeared, which ſtay'd a ttle while on the glaſs, and then vaniſhed; that he might be he better ſatisfied in this matter, on the 6th of *November* he ook a new glaſs-tube, and tho' he had very carefully ſhut it p, and cover'd it cloſe, he could ſee abundance of ſmall par-cles therein; on the ſame day it rain'd again, and he inter-epted the water as before, and put it into the glaſs-tube, to e whether there were any air-bubbles, and whether they ould diſappear like the other; he obſerv'd the water ſeveral mes, even after it had been four hours in the tube, and in hat time diſcover'd but two or three air-bubbles, which were a dry particle, from whence the air ſeem'd to proceed; he laced the aforeſaid tube perpendicularly, and another bliquely, almoſt horizontally, only that the orifice was iſed a little higher, that the water might not run out, and hat the air-bubbles might keep their place in the uppermoſt arts of the tube; after the ſpace of 10 hours, he ſaw a great umber of air-bubbles, that were for the moſt part faſtened to he ſaid atoms; and whereas no dry particles, nor any other hat have air included in them, can admit of water, till the r is firſt diſlodged; this rule holds alſo in the particles that e found in the glaſs-tube; but, ſome of the air-bubbles were oo, and others ſeveral 100 times bigger than the atoms to hich they were fixed; next day, in the morning, he could erceive but four very ſmall air-bubbles, and a few hours after ey were all gone; M. *Leewenhoeck* viewed this water till e 14th of *November*, but could not ſee any *Animalcula* erein: A certain fiſherman brought M. *Leewenhoeck* ſome ls no bigger than a large pin, in ſome of which, that were a darkiſh colour, he could very diſtinctly ſee the blood rculate, notwithſtanding the exceeding ſmallneſs of the ſſels; but next day viewing one of thoſe little animals, that as changed almoſt white, he could hardly ſee the circulation the blood, which, even in the largeſt veſſels (by reaſon of e few globules therein) had ſcarcely any tincture of red.

oman Coins *and other Obſervables in* Lincolnſhire; *by Mr.* Thoresby. Phil. Tranſ. N° 279. p. 1156.

ONE *Edward Lenton*, being about to fence in a hay-ſtack, and digging a grip for that purpoſe about half yard deep, he ſtruck his ſpade upon a pot, which when he

broke, he found therein 36 pounds weight of old *Roman* copper coins; the pieces had been ſet in rows edge-ways one by another, and ſtuck ſo together with the verdigreaſe, or ruſt of copper, that ſeveral requir'd a chiſſel, or ſome ſuch thing to ſeparate them; but being ſeparated, cleaned, and brightened, the heads, or figures of all, or moſt of them, were very fair, (ſome as if newly ſtamp'd) and the inſcriptions of ſeveral were very legible; the place where they were found, was in the midſt of the largeſt flat, or level, in *England*, and in a ground that for ſeveral years paſt uſed to be cover'd with water in winter, and overgrown with reeds in ſummer; it is about a mile and a half ſouth and by weſt from *Fleet-church*, and as far ſouth and by eaſt from *Holbeach*; there are no banks nor hillocks, old works, nor ruins to be ſeen near it, nor the remains of any thing extraordinary therein; only about two or three miles off there is an old ſea-bank, which *Dugdale* from a paſſage in *Tacitus*, takes to have been caſt up by the *Roman* ſoldiery; but all is as level as the ſea, and an entire low country, producing a coarſe flaggy graſs for the moſt part round about it; the pot, which was narroweſt at the top and bottom, but thicker in the middle, had an inſcription round it, which, tho' it ſeem'd in ſome of the ſherds to be fair at firſt ſight, yet was not legible.

Near the river *Welland*, that runs thro' the town of *Spalding* in *Lincolnſhire*, at the depth of about eight or ten foot, there were *Jetteys* found, as they call them, to prop up the old river bank; as alſo, the head of a tunnel that emptied the land water into this river; and at about 20 or 30 yards diſtance from this river, there were dug up, at the like depth, ſeveral old boats; all which ſhew that the river was formerly, either much wider than it is now, or ran in another channel, or both; on the north-weſt ſide of the river, and more upwards in the town, were dug up, about the afore-mentioned depth, the remains of old *Tan-vats*, or pits; a great quantity of ox-horns, ſhoe-ſoles, and the very tanners knobs, *&c.* which ſhews, that the ſurface of the country lay formerly much lower than it does now, and has been raiſed by the ſea's throwing in ſand on the maritime parts (which are now moſtly inhabited) and by the moor or rotted ſedge in the fenny parts next the high country; the whole level is about 50 miles in length, and 30 miles over in the broadeſt parts; no record, either printed or manuſcript, or tradition whatſoever, informs us, when theſe mutations happened.

At

At the laying of a new ſluice, or gout, as they call it, at the end of *Hamorebeck*, at its fall into *Boſton* haven, upon taking up the foundation of the old ſluice, they met with the roots of trees, ſeveral of which iſſuing from their reſpective boles, or trunks, ſpread in the ground; and upon taking up the roots, and the ſoil they grew in, they met with a ſolid, gravelly, and ſtony ſoil of the high country kind (but black and diſcoloured, by the change it had undergone) upon which hard bottom they laid the foundation of the new ſluice, which was certainly the ſurface of the old country before it was covered by the ſea, and was much deeper than that at *Spalding*, as the land there is at preſent higher.

Mr. *Thoresby* takes this to be an experimental confirmation of Mr. *Ray*'s ſentiments in his *Phyſico* theological tract, concerning the great changes made in the terraqueous globe; *viz.* that the great level of fens running thro' *Holland* in *Lincolnſhire*, the iſle of *Ely* in *Cambridgeſhire*, and *Marſhland* in *Norfolk*, had been ſometimes a part of the ſea, which by degrees had been raiſed up by the mud and ſoil, carried down by floods from the upper grounds, ſubſiding there.

Strange Epileptic Fits; *by Dr.* Leigh. Phil. Tranſ. N° 280. p. 1174.

IN 1702, there was an epidemical fever, attended with very ſurpriſing ſymptoms; in the beginning, the patient was frequently attack'd with the *Colica Ventriculi*, convulſions in ſeveral parts, ſometimes violent vomitings, a dyſentery, the jaundice, and in ſeveral patients there was a ſuppreſſion of urine; and what urine was made, was highly ſaturated with choler; about the ſeat of the diſtemper, there appeared large purple ſpots, and on each ſide thereof two large bliſters, which continued three or four days; theſe bliſters appeared about the ſpots in ſuch a manner, that they might in ſome meaſure be called *Satellites*, or attendants thereon; of theſe there were in ſeveral patients four different eruptions; but the moſt remarkable inſtance the Dr. ſaw in this fever, was, in a boy of *Lyme* in *Cheſhire*, about 13 years of age, who was afflicted with the following ſymptoms; upon the *Criſis*, or turn of the fever, he was ſeized with an *Aphonia*, and continued ſpeechleſs ſix weeks, with the following convulſions; the diſtemper infeſted the nerves of both arms and legs, which produced the *Chorea S. Viti*, or St. *Vitus*'s dance; both his legs were contracted in ſuch a manner, that no perſon could reduce them

to their natural poſition; beſides theſe, he had moſt terrible ſymptoms, which began thus; the patient could perceive the fits coming on about the *Os Sacrum*, or extremity of the back-bone, and the region of the navel; and then, the diſorder, as he imagined, united about the top of his head; immediately after, he fell into ſuch violent convulſions in the *Abdomen*, or lower cavity, that ſometimes two or three perſons were obliged to lie upon him to keep him in bed, his body being frequently raiſed from it; after this, the nerves of the lungs were immediately affected, and then he barked in all the uſual notes of a dog; ſometimes ſnarling, at other times barking, and at laſt howling like a hound; afterwards, the nerves of the mandibles were convulſed, and then his jaws claſh'd together with ſuch violence, that ſeveral of his teeth were beaten out, and then, oftentimes there came a great foam from his mouth; afterwards, he had an exceeding wild look, ſnatching at any thing near him, and he would have tore off his fleſh, had he not been prevented by the perſons about him; this made the Dr. conjecture that he might formerly have been bit by a mad dog, which had introduced the *Hydrophobia*; but he was convinc'd to the contrary, by putting a baſon of water by him, of which he was not in the leaſt afraid, nor did he attempt to lap it; the Dr. ſaw him in three of theſe fits; but, at other times, in theſe convulſions, he roared like a bull, made a noiſe like a hog, and ſometimes like that of a goſling; all which different ſounds, the Dr. took to proceed from the different contractions of the lungs, variouſly forcing out the air; and conſequently, as they were differently convulſed, they form'd various ſounds: In a week's time, the Dr. recover'd the boy to his ſpeech; his ſenſes returned, and his convulſions were gone; there were others in this country affected much after the ſame manner: From this caſe it is evident, that theſe diſtempers are natural, ſince it cannot be imagined, that a diabolical ſpirit ſhould be ejected by a regular courſe of phyſic.

Figures of the Arteries *and* Veins *explained, with* Anatomical *and* Chirurgical Obſervations; *by Mr.* William Cowper. Phil. Tranſ. N° 280. p. 1177.

THE ſchemes of the arteries and veins were done after the veſſels themſelves were paſted and dried; and which were diſſected from adult human bodies, and diſplayed on tables in the repoſitory of the Royal Society; and were the preſent of *John Evelyn*, Eſq; who gives the following account of them.

'Being

'Being ſome years ſince in *Italy*, and curious of ſeeing the many repeated diſſections at the anatomical theatre at *Padua*, *Cavalier Veſlingius* being then profeſſor, and reading on divers bodies ſeveral days, during *Lent*; Dr. *Johanno Athelſteinus Leoncenæ*, who was then operator, by extracting the veins and other veſſels, which contain the blood, ſpirits, *&c.* out of human bodies, began to apply and diſtend them on tables, according to their natural proportion and poſition; ſome of theſe tables being finiſhed by the direction and public approbation of the profeſſor, and ſeveral other learned phyſicians and anatomiſts, preſent at theſe lectures and operations; and underſtanding that *Leoncenæ* was about to diſpoſe of his tables, I deſired Dr. *Geo. Rogers*, then Conſul at *Padua*, for the ſtudents of our nation in that univerſity, to purchaſe and procure them for me; which he did for 150 *Scudi*; with condition that he ſhould add a table more; *viz.* that of the liver, gaſtric nerves, and other veſſels to complete the fourth.'

Mr. *Cowper* finds the arteries here very agreeable, which he drew from the arteries of a *Fœtus* injected with wax; but the figure of the veins differs ſo much from any extant, as would incline one to ſuſpect all of the ſubject hitherto publiſhed.

It is well known that the arteries are the veſſels, which convey the blood from the heart, to all parts of the body; and it is the common practice of nature, in the diſtribution of theſe veſſels, to ſupply the parts with blood from the next adjacent trunk, till their aſcending and deſcending trunks become conical, as well as their collateral branches; not that all the trunks and ramifications of arteries are uniform, and become conical in the ſame manner; nor do all of them paſs directly to the parts to which they convey blood; nor do all the parts receive arteries from their neighbouring trunks; for, the trunks of the carotid, vertebral, and ſplenic arteries in adults, are not only contorted in their progreſs, but the diameters of their bores are variouſly dilated in divers parts, eſpecially where they are contorted; but, as theſe dilatations of their trunks are cauſed by the reſiſtance which the blood meets with at thoſe angles of inflection, ſo theſe enlargements of them afterwards, contribute to retard the protruſion of the blood to the extremities of thoſe arteries; hence it is, that as the arteries in a *Fœtus* are not contorted in ſuch acute angles as in adults, ſo, their trunks are more conical, and not dilated in divers parts here and there, as in the latter; the trunk of the ſplenic artery has

has a ſtrait progreſs in the *Fœtus*, and in infants; but in adults Mr. *Cowper* had conſtantly found it very much contorted.

The peculiar contrivance of the ſpermatic arteries in quadrupeds, as well as in men, ſhews a conſtant deſign in nature in taking off that velocity, with which the blood would otherwiſe paſs thro' the glands of the *Teſtes*; it ſeems, that for this end, the *Teſtes* of moſt animals (eſpecially men, and quadrupeds) hang out of the cavity of the *Abdomen*, that the canals of their blood-veſſels may be thereby lengthened; for the ſpermatic arteries, contrary to all others, ariſe from the great trunk, at a far greater diſtance from the *Teſtes*, than the arteries of any other part of the body; nor would the *Teſtes*, which are ſuch neceſſary organs, have been thus expoſed to external injuries, if the deſign of nature in lengthening their blood-veſſels had not been very conſiderable; beſides this lengthening of the ſpermatic arteries, we find nature ſtill contriving other impediments to check the current of the blood in thoſe parts; for this purpoſe, it ſeems that the ſpermatic arteries are leſſened at their origin from the trunk of the *Arteria magna* in men, and that the ſpermatic arteries of quadrupeds are ſo much contorted, before they reach the *Teſtes*; the principal deſign of nature in theſe different contrivances ſeems to be, that if the human ſpermatic arteries were contorted, as in quadrupeds, before they reach the *Teſtes*, the apertures in the abdominal muſcles of men muſt have been much larger than they now are, and would frequently let the inteſtines fall into the *Scrotum*; which nevertheleſs often happens; ſuch ruptures are not ſo incident to quadrupeds, tho' the paſſages for their ſpermatic veſſels thro' the abdominal muſcles, are much wider than in men, becauſe the poſition of the trunks of their bodies is horizontal, and their inteſtines therefore cannot preſs on the proceſſes of the *Peritonæum*, as in men, who are erect.

After that the circulation of the blood thro' the heart, lungs and large blood-veſſels, was demonſtrated by Dr. *Harvey*, it was only gueſs'd how the extremities of the arteries tranſmitted the blood to the veins, till M. *Leewenhoeck* diſcovered by his microſcopes the continuation of the extremities of thoſe veſſels in fiſhes, frogs, *&c.* yet ſome doubt of the like continuations of the extremities of arteries and veins in human bodies, and in quadrupeds, ſince thoſe animals, it has hitherto been ſeen in, have been either ſuch fiſh, or of the amphibious kind, that have but one ventricle in their hearts, and their blood actually cold, excepting in batts, where it appears very obſcurely; beſides, that the blood in thoſe animals does not circulate with ſuch rapidity as in ſuch whoſe

heart

earts have two ventricles; for in all animals that have bi-ventrous earts, the veſſels of the reſt of the body return their blood to he heart in equal time and quantity, with thoſe of the lungs, otwithſtanding the inequality of their courſe.

This difference in the principal organs of the circulation of he blood in thoſe animals (on which only theſe experiments have een hitherto made) induced Mr. *Cowper* to make ſome on ani-nals, whoſe organs differ from the human, in their groſs figure nly, and not in their intimate ſtructure; for this end Mr. *Cow-er* took a young cat, about 10 or 12 days old, and faſtened it o a board, as in vive-ſection; and making an inciſion thro' the *Linea alba*, the *Omentum* and inteſtines were extruded; then aufing this animal to be held on the board, under a large double nicroſcope, where a flat glaſs for receiving of objects was placed orizontally, on which Mr. *Cowper* expanded the *Omentum* or aul (a light being placed underneath) he ſaw the globules of the lood move very ſwiftly in the ſmall veſſels, which are only to e ſeen in the moſt tranſparent parts of the membranes of the *mentum*; but the motion of the blood ſoon abated, and its glo-ules were withdrawn from the extremities of its blood-veſſels, nd in a little time became ſtagnant in their larger branches; Mr. *Cowper* ſaw very well this continuation of the extremities of he arteries with the veins, while the blood moved therein, in the *mentum* of a young lean dog, that was not large; but by the ſſiſtance of an inſtrument he had prepared to expand the meſen-ry, he ſaw it there much better; that part having not only arger and clearer ſpaces than the *Omentum*, but having its blood-eſſels diſtributed more regularly; thoſe who would view with nicroſcopes the tranſparent parts of animals, will find that the ex-remities of their arteries and veins are not all equally leſſened, ho' united; in the tail of the *Lacerta aquatica*, tadpoles, and f moſt fiſh, Mr. *Cowper* frequently obſerved ſeveral communi-ations between the arteries and veins, in which more than two lobules of blood have paſs'd a-breaſt; and in the ſame area he aw ſome of thoſe communications ſo ſmall, that only one globule ould paſs, and that very ſlowly before the other; in young fiſh, articularly in grigs, he frequently obſerved a communicant ranch, ſo very ſmall, as that only one globule of blood paſſed in two or three ſeconds; at other times he found conſiderable ntervals between the paſſing of one globule in ſuch a communi-ant branch, even half a minute, a whole minute, and once in wo or three minutes he has ſeen one globule of blood only paſs a particular tract; the ready paſſing of injections by the ſple-

nic

nic arteries to the veins, ſhews that the communications between thoſe veſſels are more open than the arteries and veins of other parts; as alſo injections made into the pulmonic arteries paſs to their veins, tho' not altogether ſo freely, as in the ſpleen.

On viewing with a microſcope the extremities of the pulmonic blood-veſſels in a live frog, Mr. *Cowper* found their communications much larger than thoſe he had formerly ſeen in the membrane between the toes, and in the feet of the ſame animal; nor can we reaſonably doubt of the like patent communications of the arteries and veins in human lungs, and thoſe of quadrupeds, when we conſider, that the blood of the lungs muſt return to the heart in equal time and quantity, with that of all the parts of the body beſides; hence it appears, that the bronchial blood-veſſels (firſt taken notice of by *Ruyſch*) are abſolutely neceſſary, elſe the parts of the lungs could not receive their nouriſhment, nor could the glands of the *Bronchiæ* ſeparate their liquor, if they were ſupplied with blood from the pulmonic blood-veſſels, which is ſo quickly diſpatched thro' the lungs; on viewing the membrane, that is between the toes of one of the hinder feet of a live frog, after having frequently taken hold of the ſame leg of that animal, in order to apply it to the microſcope, Mr. *Cowper* found that membrane very tranſparent, and without any motion of the globules of the blood therein, as if the part had been dead; but, while he was looking thereon, he ſaw the globules creep into it by degrees, and at length the blood moved in all the branches of its veins and arteries as before, when no violence had been offered to the part; whilſt the blood is thus leiſurely creeping thro' the veſſels, you may plainly ſee its globules compreſſed into oval figures, which are made more or leſs oblong, by the reſiſtance they meet with by the contraction of the ſides of the veſſels thro' which they are tranſmitted; and this Mr. *Cowper* frequently obſerved in the tails of the water *Newts*, or lizards; but on examining with a microſcope the blood of theſe animals, and comparing it with the human blood, he found the globules of the lizard's blood incline more to an oval figure, and were as big again as thoſe of human blood; and in like manner he viewed at another time the blood of a ſmall fiſh: It is not unlikely that a ſudden retroceſſion of blood from the extremities of its veſſels often happens, and its circulation in the ſame veſſels, is afterwards carried on without any impediment, on occaſion of ſome paſſions of the mind, *deliquiums* by the effuſion of blood, or otherwiſe; but if the blood is once become ſtagnant in its veſſels, eſpecially the arteries, the part is in a

ſmall

nall danger of a mortification; unleſs its neighbouring veſſels, hich enjoy a circulation, propel the ſtagnant blood, ſo as to ſcape by the ſides of the veſſels that retained it: Experience ſures us, that in bruiſes where the blood is extravaſated, it es off either by tranſcolation, or elſe cauſes an abſceſs; for ere is little reaſon to ſuppoſe that any of the ſtagnant globules the blood will be fit to re-unite with the circulating maſs: t that the blood after ſtagnation in its veſſels will ſometimes aſs their ſides, appeared to Mr. *Cowper* from the following periment;

On viewing the meſentery of a dog when alive, wherein he d before ſeen the blood paſſing the extremities of the arteries d veins, he conſidered how he might preſerve the blood in its ſſels, that he might any time afterwards ſee it in their extre-ities, when ſtagnant; for this end he cauſed ſeveral parts of e meſentery to be tied on ſo many pieces of ſmall round pill-xes, cut tranſverſely like little hoops, on which, portions of e meſentery were extended like the head of a drum; and on ewing them afterwards with his microſcope, he found the ex-emities and branches of the blood-veſſels charged with blood, hich before appeared in motion; on putting one of theſe ex-nded parts of the meſentery in water, the ſtagnant blood in veſſels diſappeared; but on juſt immerſing another of thoſe eces in water, Mr. *Cowper* could with his naked eye ſee the agnant blood diffuſed in the interſtices of the blood-veſſels, and tween the membranes of the meſentery; from hence it is evi-nt, that the blood may after ſtagnation paſs the ſides of its ſſels, but whether its globules are broken, or what figure ren-rs them fit to paſs thoſe pores that are in the ſides of the veſ-ls, Mr. *Cowper* leaves to others to determine.

As the arteries are known to convey the blood, ſo the veins turn it to the heart, and here as in the arteries, we find the mmon practice of nature, in diſpoſing the branches of the ins to diſcharge the refluent blood into the next adjacent trunk, d ſo on to the heart; and as the arteries afford abundance of ſtances of checks given to the velocity of the blood's current ro' ſeveral parts, ſo the veins ſupply us with as many artifices aſſiſt its regular return to the heart, as well as favour thoſe ntrivances in the arteries; the trunks of the carotid, vertebral, d ſplenic arteries, are not only variouſly contorted, but alſo di-ed here and there; ſo the veins that correſpond to thoſe ar-ies are alſo variouſly dilated; the beginnings of the internal gulars have a bulbous cavity, which are *diverticula* or checks

to the refluent blood in the *Sinus* of the *Dura Mater*, leſt it ſhould deſcend too faſt into the jugulars; the like has alſo been obſerved by Dr. *Lower* in the vertebral *Sinus*; the ſplenic vein has divers cells opening into it near its extremities in human bodies; but in quadrupeds the cells open into the trunks of their ſplenic veins; the ſpermatic veins do more than equal the length of the arteries of the *Teſtes* in men; their various diviſions, ſeveral inoſculations and valves, are admirably contrived to ſuſpend the weight of the blood, in order to diſcharge it into the larger trunks of the veins; and were it not that the refluent blood from the *Teſtes* is a *Pondus* to the influent blood from the arteries, and ſtill leſſens its current in the *Teſtes*; theſe ſpermatic veins, like thoſe of other parts, might have diſcharged their blood into the next adjacent trunk: Who can help being ſurpriſed at the art of nature, in contriving the veins that convey part of the refluent blood from the lower parts of the body, when we conſider, the neceſſity of placing the human heart, as well as that of moſt quadrupeds, ſo far from the center of the body towards its upper part? For that end it is neceſſary that the large trunks of the veins and arteries ſhould not aſſociate with each other; for if all the blood ſent into the lower parts, by the deſcending trunk of the *Aorta*, ſhould return again to the heart by one ſingle trunk, as it is ſent out from thence, the weight of ſo much blood in the aſcending trunk of the *Vena Cava* would oppoſe the force the heart could give it from the arteries, and hinder its aſcent; for this reaſon the *Vena Azygos*, or *ſine pari*, is contrived to convey the blood ſent to the muſcles of the back and *Thorax* into the deſcending trunk of the *Vena Cava*, above the heart; hence it is evident, that more blood comes into the heart, by the deſcending or upper trunk of the *Vena Cava*, than paſſes out by the aſcending trunks of the *Aorta*; nor does this quantity of blood, conveyed to the heart by the ſuperior trunk of the *Cava*, ſeem without ſome other deſign in nature, beſides tranſporting it thither to free the inferior trunk from its weight; but perhaps it was neceſſary ſo much blood ſhould be ready there to join with the chyle, for its better mixture, before it reaches the right auricle of the heart; Mr. *Cowper* diſcovered a peculiar valve in the lower trunk of the *Vena Cava*, near the right auricle of the heart.

Plate V. Fig. 1. repreſents the trunks and large branches of the arteries diſſected from an adult human body, when diſplay'd and dried. 1. The trunk of the *Aorta* cut from the baſis of the heart: 2. That part of it, whence the coronary artery of the heart ariſes: 3. That part of the *Arteria magna*, where the

Canalis

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Fig. I.

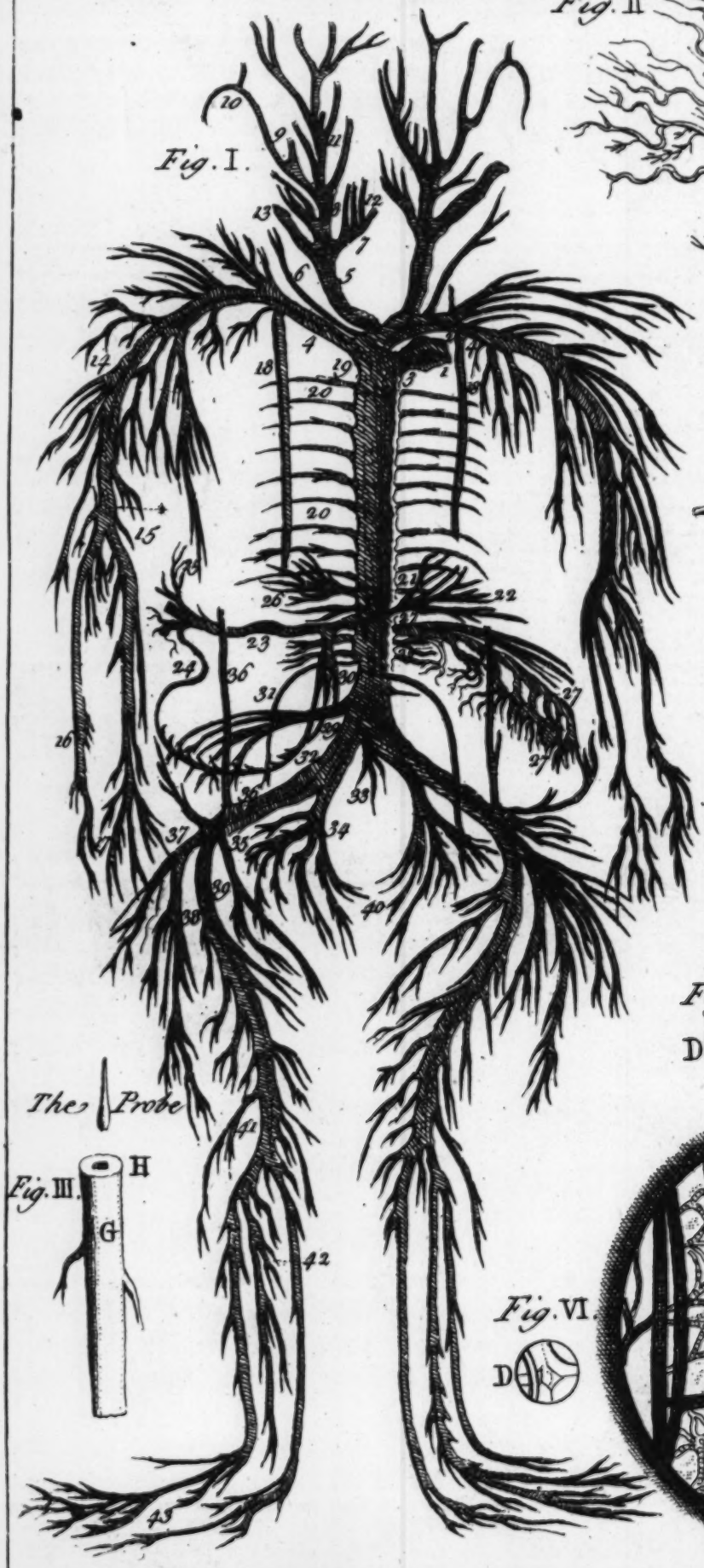


Fig. II



Fig. IV.



Fig. VI.



Fig. V.

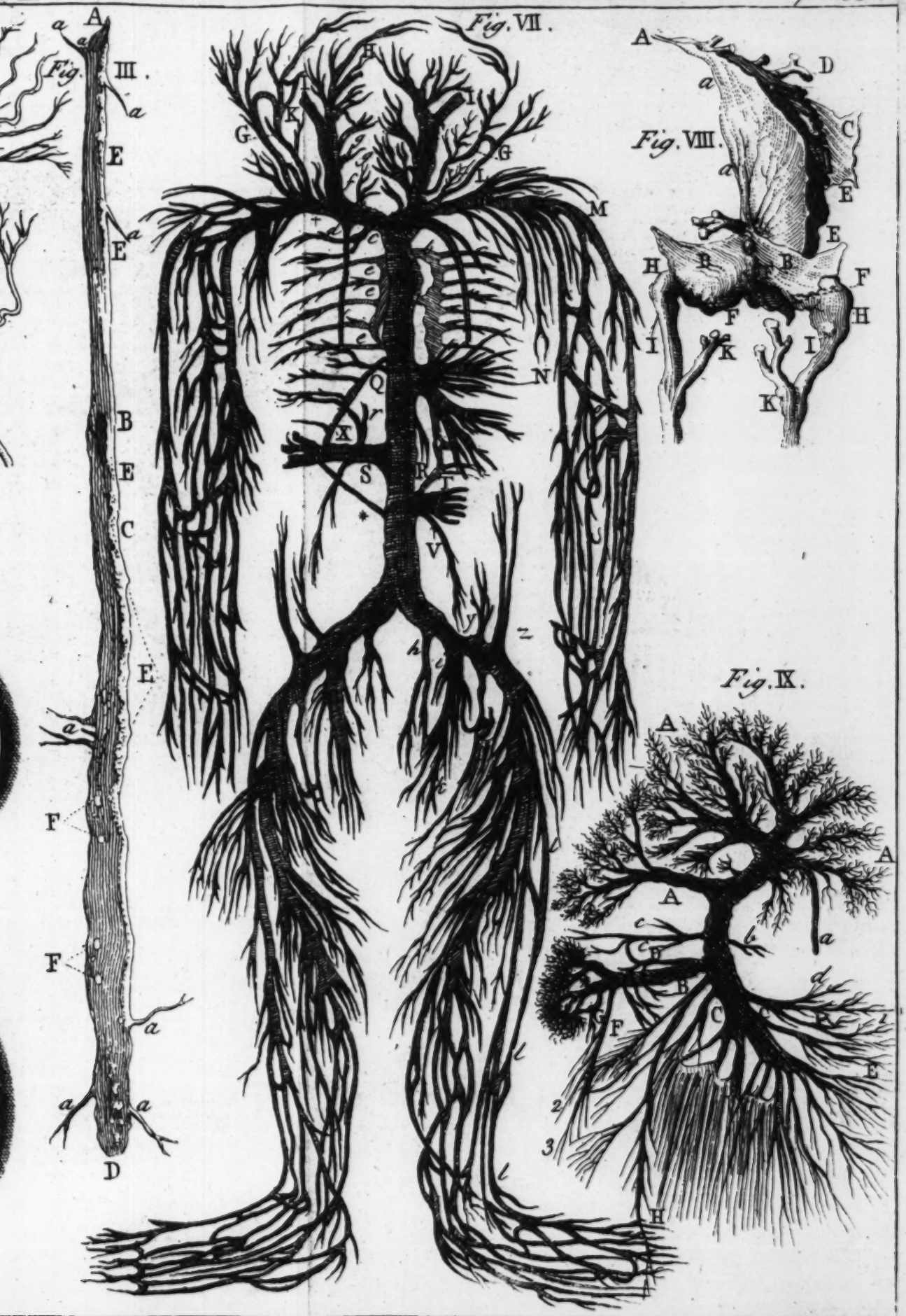


Fig. VI.

The Probe

Fig. III.

G. Smith del.



Hulett Sculp

Canalis arterioſus of the *Fœtus* terminates, which in an adult, becomes a ligament: 4 4. That part of the axillary arteries, called by ſome the ſubclavian arteries: 5. The left carotid artery, which in this ſubject ſeems to ariſe from a common trunk with the right carotid, and axillary arteries, as in ſome quadrupeds; 6. The left cervical artery, in this ſubject ariſing from the trunk of the *Arteria magna*, as expreſſed in a figure given by *Bergerus* in the *Acta Eruditorum Anno* 1698, p. 295; but in all the human ſubjects Mr. *Cowper* had examined, he conſtantly found them as expreſſed 6. 6. Fig. 2: 7. The arteries that carry blood to the lower parts of the face, tongue, adjacent muſcles and glands. 8. The trunk of the temporal artery, ariſing from the carotid, and emitting branches to the parotid gland 9, and temples 10, and parts adjacent: 11. The occipital arteries: 12. The arteries that convey blood to the *Fauces*, *Gargareon*, and adjacent muſcles: 13. The trunk of the carotid artery cut off, before it is contorted in paſſing the ſcull: 14. The trunk of the artery of the arm ſending out branches to the adjacent muſcles, and parts* that part of this artery, which is ſometimes prick'd in letting blood, and cauſes an aneuriſm; in which caſe this trunk of the artery muſt be bar'd and tied hard above the aneuriſm; and if it afterwards happen (as has frequently been known) that the flux of blood to the aneuriſm in the artery is not very much abated, tho' the artery has been tied above; the operator, in that caſe, muſt make another ligature on the trunk of the artery below its aneuriſm; theſe collateral communications of the trunk of the artery at the bending of the cubit, preſerve the circulation of the blood in the cubit, and hand; tho' the trunk is totally compreſſed both above and below, and the ſame trunk, afterwards divided between thoſe ligatures; hence it is, that if one ligature, made above the wound in the artery, is not ſufficient, but the blood ſtill pours out from below, the patient will ſooner recover the action, and ſtrength of the muſcles of the cubit, than thoſe in whom the upper ligature proves ſufficient; the reaſon of which is obvious, to any one who conſiders that the communicant branches muſt be larger, where the lower ligature is required, than when the ſuperior ligature only is ſufficient; theſe communicant branches, as Mr. *Cowper* has ſeen them in ſome ſubjects, are marked out in this figure by prickt lines.

The two following inſtances happened, in which the communications of the large trunks of the arteries of the cubit, and arm were remarkable; a boy of 13 years of age, who about 3 weeks before Mr. *Cowper* ſaw him, had received a wound near

the middle of the cubit, in which the trunk of the artery (marked †) was divided; the ſurgeon, who was firſt called, had frequently bound up the wounds, and put a ſtop to the ſeveral diſcharges of blood (amounting to about 6 or 7 quarts at times) but not without a compreſs on the trunk of the artery, above the wound; on another impetuous flux, Mr. *Cowper* was called, who ſeeing a pretty large quantity diſcharged, he only bound up the wound, in the ſame manner as it had been done before, omitting the compreſs on the trunk of the artery above, and adding a piece of deal-board, upon which the hand and cubit were faſtened, to prevent any motions of thoſe parts, as well as of the fingers; three days after, the applications were taken off, and little or no blood appeared; but two or three hours were ſcarcely elapſed, before Mr. *Cowper* was alarm'd with notice of a freſh flux; the by-ſtanders being inſtructed in that caſe, to compreſs the trunk of the artery above the cubit, they thereby prevented no ſmall effuſion of blood, which muſt otherwiſe have happened; Mr. *Cowper* laid bare the trunk of the artery above the wound as expeditiouſly as he could, being obliged more than once to let looſe the compreſs above, in order to diſcover its orifice by the flux of blood; he paſs'd a needle with ſtrong waxed thread under the artery, and made a ligature on its trunk, which lay concealed in the interſtice of the *Muſculus flexor digitorum*, and the *Muſculus Ulnaris flexor carpi*; but notwithſtanding this ligature on the trunk of the artery above the wound, the blood ſtill flowed from the lower trunk of the divided artery; yet the velocity of its current was ſo much abated, that it ſeemed like blood flowing from a vein; he left the wound with a digeſtive, and the part without a hard bandage; and five weeks afterwards, Mr. *Cowper* heard that the wound was almoſt cicatrized.

A boy about eight years of age came to *London* with an aneuriſm of the left arm, having bled for ſix weeks before; the tumor was indeed very large, in proportion to ſo ſmall an arm; after laying the aneuriſm, or tumor bare, and making a ligature on the ſuperior trunk of the artery (at *..... in the figure) Mr. *Cowper* found, on looſening the compreſs on the ſuperior trunk of the artery, very little abatement of the pulſation of the aneuriſm; he then paſſed a ligature in like manner on the trunk of the artery below the tumor, but the pulſation ſtill continued, tho' much abated; he then diſcovered another trunk of the artery, ariſing from the lower part of the tumour, on which he alſo made another ligature, and the pulſation then ceaſed; however, on cutting off the ſurface of the *Cyſtis*, or dilated artery,

and

and clearing it of the coagulated blood, there ſtill poured out ſome freſh blood, which was ſoon ſtopped with a common aſtringent; Mr. *Cowper* left the part without any other ligature, or hard bandage; 18 days after the operation, the ligatures on the arteries were all taken off, and the pulſation of the artery of the wriſt began to be very ſenſible, no ſymptoms appearing that threatened any danger: This patient recovered the uſe of his arm, and was afterwards in perfect health.

15. Repreſents the diviſion of the trunk of the artery of the arm below the flexure at the cubit; 16 the external artery of the cubit, which cauſes the pulſation commonly felt near the *Carpus*; 17 the arteries of the hand and fingers; 18 the mammary artery; 19, 19, the deſcending trunk of the *Arteria magna*; 20 20 the intercoſtal arteries; 21 the *Arteria cæliaca*; 22 the *Arteria hepatica*; 23 the trunk of the *Arteria ſplenica*; 24 the *Arteria epiploica ſiniſtra*; 25 a branch of an artery, which paſſes to the bottom of the ſtomach; 26 the ſuperior coronary branch of the ſtomach; 27, 27 the ſuperior meſenteric artery; 28, 28 the emulgent arteries; 29 the inferior meſenteric artery; 30, 30 the lumbal arteries; 31, 31 the two ſpermatic arteries, which ſeem to ariſe in this ſubject at a greater diſtance from each other, than they do commonly; 32 the *Iliac* artery; 33 the *Arteria ſacra*; 34 the internal *Iliac* branch; 35 the external; 36 the epigaſtric artery; 37 branches of the external *Iliac* artery, paſſing to the oblique muſcles of the *Abdomen*; 38, 38, the arteries that paſs to the muſcles of the thigh, and *Tibia*; 39 the crural artery; 40 the umbilical artery, with thoſe of the *Penis*; 41 that part of the crural trunk, that paſſes the ham; 42 the three trunks of the arteries of the leg; 43 the arteries of the foot and toes.

Fig. 2. repreſents the trunks, and ſome of the ramifications of the arteries of an adult human body, filled with wax; to ſhew the variety in nature, and ſupply the defects of the former figure; 1 the *Aorta*, cut off at the baſis of the heart; A the three ſemi-lunar valves, as they appear, when the heart is in *Diaſtole*, and hinder the blood's coming back from the arteries into the left ventricle of the heart; B a portion of the trunk of the *Arteria pulmonalis*; *b b* its diviſion before it paſſes to the right and left lobes of the lungs; C the deſcending trunk of the *Arteria magna*; DD the internal mammary arteries; 2 the trunk of the coronary cut off; 3 the *Ligamentum arterioſum*, which in a *Fœtus* is the *Canalis arterioſus*, and conveys blood from the pulmonary artery to the great artery; 4 the trunk of the ſubclavian artery; 5, 5 the carotids; 6, 6 the vertebral arteries;

7, 7

7, 7 the arteries, which paſs to the lower parts of the face, tongue, adjacent muſcles and glands; 8, 8 the trunks of the temporal arteries, ariſing from the carotids, furniſhing the parotid glands with branches 9, 9, and the temples 10, 10 *&c.* 11, 11 the occipital arteries; 12 the arteries of the *Fauces Gargareon*, *&c.* 13, 13 the contortion of the carotid arteries, as they paſs the baſis of the ſcull; theſe trunks of the carotid arteries in dogs (and as Mr. *Cowper* ſuppoſes, in moſt quadrupeds) are very much contorted, before they reach the baſis of the ſcull; on injecting theſe veſſels of that animal with wax, he found thoſe branches of them, which paſs to the brain (firſt clipping the hinder parts of the lower jaw) immediately under its condiloid proceſſes, where thoſe arteries are received in two *Sinus*'s of that bone; which *Sinus*'s may be alſo ſeen in the jaw-bones of other quadrupeds, but not in human ſubjects; 14, 14 thoſe parts of their trunks, that paſs by each ſide of the *Sella Turcica*, whence divers ſmall branches ariſe, and help to compoſe the *Rete mirabile*, which is more conſpicuous in quadrupeds than in human ſubjects; 15, 15 the contortions of the vertebral arteries, where their trunks are conſiderably dilated; 16 the vertebral arteries, as they aſcend on the *Medulla Oblongata* towards the annular protuberance, or *Pons Varolii*; 17, 17 the communicant branches of the vertebral and carotid arteries; 18, 18 the arteries of the brain diſplayed.

Fig. 3. repreſents one of the trunks of the arteries of the *Tibia*, diſſected from the leg of one Mr. *Stringer* after amputation; he was in his 67th year when this artery was taken from him, and for upwards of 20 years before, he had loſt the uſe of both his legs; and in that time he had been ſo afflicted with convulſions in them, that neither leg was free a quarter of an hour together, whether ſleeping or waking; at length one of his little toes was mortified, which was cut off; not long after more toes of the ſame foot were alſo mortified; the convulſions in that leg becoming ſtronger and quicker, that part of the foot next the toes became tumid and inflamed, the tumor extending itſelf above the *Malleoli*; a ſinuous ulcer paſſed by the ſide of one of the metatarſal bones, the extremity of which bone, whence the toe was cut off, lying bare; in this condition Mr. *Cowper* found the left foot and leg of this gentleman, and finding the leg very chilly, the neceſſity of parting with it was too evident on the abciſion, which was about five or ſix inches below the knee, Mr. *Cowper* was ſurpriſed to ſee ſo little blood come from the arteries; and examining the arteries of the amputated leg, having before

before diſcovered the cauſe of a mortification of a young gentlewoman's arm, who died ſoon after an imputation of the part, tho' the gangrene did not appear to reach near the place where the abſciſion was made, *i. e.* below the ending of the *Muſculus Deltoides*; in which caſe Mr. *Cowper* found the ſides of the trunk of the artery of the arm ſo thicken'd, that the diameter of its bore was contracted to leſs than a third part and would ſcarcely admit a common probe; when he had found the ends of the arteries in the leg abovmention'd, he endeavour'd to paſs his probe into one of them; but meeting with ſome oppoſition, he ſuſpected he had miſtaken the vein for the artery, and that the valves oppos'd the paſſing of the probe that way; but on further diſſection, he clear'd the trunks of both thoſe blood-veſſels, and found the veins in their natural ſtate, but the ſides of the arteries grown bony or ſtony; A repreſents the upper part of the artery cut off in the amputated leg; from A to B the trunk of the artery diſtended and dried to ſhew its canal; C that part of the trunk of the artery, which was ſo contracted by the petrifaction, or oſſification, that a probe could not paſs its canal; from C to D the trunk of the artery open'd and expanded; E E the petrifactions or oſſifications in the ſides of the arteries; F F their ſpecks in the lower part of the artery, not ſo large as in the upper part, and placed at greater diſtances; *a a*, *&c.* the branches ariſing from the trunk of the artery; G a portion of the trunk of the artery of the arm above-mention'd; H the ſides of the artery, very much thicken'd, whereby its diameter was diminiſhed in ſuch a manner, that a probe could not paſs it.

The oſſifications in the coats of the arteries have been frequently obſerv'd, eſpecially in their large trunks within the cavities of the *Thorax* and *Abdomen*; but never taken notice of in the limbs; nor that ſuch impediments in their canals have been found the cauſe of mortifications of particular parts, as in the inſtance above-mention'd; tho' Mr. *Cowper* does not doubt, but the like has often happen'd in aged perſons, eſpecially where the progreſs of the gangrene is not very ſwift, and its beginning does not ariſe from any external cauſe, the conſequences of which are commonly found fatal; when the arteries of one leg, or of any other limb, are ſo affected, we may well ſuppoſe the like in thoſe of other parts, which probably, happened in the caſe above-mention'd; for tho' no gangrene came on the ſtump, yet the other foot and its toes began to mortify about ſix weeks after the amputation, as did the parts about the hips, which were compreſs'd in lying or ſitting, before the patient expir'd.

Fig.

Fig. 4. repreſents the extremities of the blood-veſſels, as they appear with a microſcope, while the blood is paſſing thro' them in the *Omentum* of a live dog; A A the branches of arteries; and B B the veins which aſſociate; C C their leſſer branches where they ſeparate from each other, and are united again at their extremities.

Fig. 5. the like appearance in the meſentery of a live dog.

Fig. 6. D D the areæ (that are here view'd thro' a microſcope) as they appear to the naked eye.

Fig. 7. repreſents the trunks of the *Vena Cava*, with their branches, diſſected from an adult human body; A A the orifice of the *Vena Cava*, as it appears when cut from the right auricle of the heart; *a* the orifice of the coronary vein of the heart; B A the ſuperior, or deſcending trunk of the *Vena Cava*; C C A the inferior or aſcending trunk, thus diſtinguiſhed from the motion of the blood in theſe trunks, which is contrary to their poſition; D D the ſubclavian veins; † that part of the left ſubclavian vein, where the thoracic duct enters, and diſcharges itſelf of its chyle and *Lympha*; *b* the *Vena Azygos*, with its branches going to the ribs *e e*; *c* the ſuperior intercoſtal veins; *d d* the internal mammary veins; E E the right and left *Iliac* branches; F F the internal jugular veins; G G the external jugulars; H H the veins, which bring the blood from the lower jaw, and its muſcles; I I the trunks of the internal jugulars cut off at the baſis of the ſcull; *f* the veins of the *Thymus* and *Mediaſtinum*; *g g* the veins of the thyrotid glands; *h* the *Vena ſacra*; *i* the internal *Iliac* branch; *k* the external; K K the occipital veins; L the right axillary vein; M the cephalic; N the baſilic; O the median vein; P the trunk of the veins of the liver; Q the phrenic vein of the left ſide; R the right phrenic vein; *r* a large vein from the left *Glandula Renalis*, and adjacent parts; S the left emulgent vein; T the right emulgent, in this ſubject much lower than the left, which is not uſual; V V the two ſpermatic veins; X X two communicant branches, between the aſcending trunk of the *Vena Cava*, and *Vena Azygos*, by which the wind paſſes into the deſcending trunk of the *Cava*, when we blow into the aſcending at A P C; tho' the trunk at A P C is tied hard on the blow-pipe; * an uncommon branch between the lower trunk of the *Vena Cava*, and the left emulgent vein; *y* a vein which brings blood from the muſcles of the *Abdomen* into the external *Iliac* branch; *z* the epigaſtric vein of the right ſide; *l* the *Vena Saphena:* The conſiderable venous trunks, which are wanting in this ſcheme, are repreſented Fig. 8. where ſome of the

the large trunks of the veins, and their *Sinus*'s within the ſcull are exhibited, with the beginnings of the internal jugular veins, fill'd with wax, and dried together with the *Falx*, &c. A the extremity of the *Falx* cut from the *Criſta Galli*; *a* its lower *Limbus* that touch'd the *Corpus calloſum*, as it divides the right hemiſphere of the brain from the left, where the fifth *Sinus* paſſes, which is here dried and diſappears; B B the ſecond proceſs of the *Dura Mater*, which ſupported the hindermoſt parts of the lobes of the brain, and defended the *Cerebellum* from being preſs'd upon by thoſe parts of the *Cerebrum*; C a portion of the *Dura Mater* adhering to the longitudinal *Sinus*; D D ſeveral trunks of the veins of the brain cut off, before they enter the longitudinal *Sinus*; E E the longitudinal *Sinus*; F F the two lateral *Sinus*'s; G the fourth *Sinus*; *g* the veins from the *Plexus Choroides*; H H the *Bulbi*, or *Diverticula* at the beginnings of the internal jugular veins; I I the internal jugular veins; K K the trunks of the veins, which convey blood from the lower jaw, and adjacent parts.

Fig. 9. repreſents the trunks of the *Vena Porta* diſſected and diſplay'd; A A the branches of the *Vena Porta* freed from the liver; *a* the umbilical vein; B the ſplenic vein; C C the meſenteric branches, which are continued from the inteſtines; *b* the trunk of the *Vena pancreatica*, which alſo receives branches from the *Duodenum*; *c c* the *Vena Gaſtrica dextra Coronaria ſuperior*; D the ſuperior coronary vein of the ſtomach on the left ſide; E the inferior coronary branch of the ſtomach on the right ſide; and F the ſame coronary vein of the left ſide, remov'd from their proper ſituations; from theſe two laſt are continu'd the *Vena Epiploica ſuperior dextra* 1, and the *ſiniſtra* 2, with the *media* 3; G the vein call'd *Vas breve*; *d* the *Vena Duodeni*; H the *Vena Hæmorrhoidalis*, ariſing from the *Rectum* and *Anus*, in this ſubject diſcharging itſelf into the left meſenteric branch; but in other ſubjects Mr. *Cowper* found this trunk of the hæmorrhoidal veins ending in the *Ramus Splenicus*; the length of the trunk of this hæmorrhoidal vein, and its progreſs under the inteſtines, render it liable to be compreſs'd, and its refluent blood retarded; whence its branches in the *Inteſtinum Rectum & Anus* become diſtended with blood, and cauſe the *Hæmorrhoides Cæcæ & Apertæ*, which are frequently attended with impoſthumes in the *Anus*, and parts adjacent; to which diſorders they are the more incident, not only becauſe theſe hæmorrhoidal veins, like the reſt of the branches of the *Vena Porta*, are without valves, and the blood has an aſcending pro-

greſs therein; as alſo that the long trunk H is not only expos'd to the compreſſions made by the inteſtines in both ſexes, but particularly the *Uterus* in women at the time of geſtation, eſpecially near the birth, ſo compreſſes this trunk, that it is no wonder that we find women more afflicted with the hæmorrhoids at that time than at any other; the *Iliac* veins and the lymphæducts that accompany them are alſo expos'd to the like compreſſion in women with child, whence the veins of the legs and thighs become varicoſe, and theſe limbs are ſo frequently ſwell'd; which intumeſcence in an inſtance Mr. *Cowper* was acquainted with, prov'd ſo great, that at length the abdominal teguments were vaſtly extended; but the patient recover'd, beyond the expectation of ſome, on the delivery of two large children.

An Account of the Iſland of Chuſan *in* China, *&c. by Dr.* Cunningham. Phil. Tranſ. N° 280. p. 1201.

WE arriv'd at the iſland of *Borneo* on the 17th of *July* 1701, where we ſtaid but two days, the ſeaſon of the year being far ſpent; and from thence we made the beſt of our way thro' the ſtreights of *Banca*, with favourable winds and weather, 'till we came on the coaſt of *China*, which was on the 13th of *Auguſt*; then we had variable winds, which carried us a-breaſt of *Emuy* the 19th following; at which time, the north-eaſt winds ſetting in freſh, put us in great fear of loſing our paſſage; whereupon, we were obliged to turn it up againſt the wind and current all the way, the weather favouring us ſo, that we had out our top-ſails only, elſe we ſhould have loſt more ground in one day, than we could have gain'd in eight; the laſt of *Auguſt* we came to an anchor under the *Crocodile Iſlands*, both to ſhelter us from the bad weather (which is generally expected on this coaſt at new and full-moon, and has been fatal to ſeveral ſhips) as alſo to look for freſh water, which was now grown ſcarce with us, not having recruited ſince we came from the *Cape of Good Hope*; theſe are three ſmall iſlands lying in the latitude of 26 degrees, about 6 leagues from the river of *Hockſieu*; on two of which we found very good freſh water, with a convenient watering place on the ſouth-weſt ſide of the innermoſt of the three; by the aſſiſtance of a few *Chineſe* fiſhermen, we procur'd ſome freſh proviſions from the main land; while we lay here, on the 5th of *September* we had a ſudden ſhort ſhift of the *Monſoon* to S. W. the fury of which others felt, in coming at the ſame time upon the coaſt of *China*; the 8th we put to ſea again, turning to windward day and night, without all the iſlands, which are very

very numerous along this coaſt, to which we were altogether ſtrangers beyond *Emuy*; and the hydrography thereof is hitherto ſo imperfect, that there was no truſting to our charts, which made our navigation ſomewhat more dangerous; however, on the 1ſt of *October* we got into the latitude of 30 degrees, where we came to an anchor near the land, till we found the way by boat to *Chuſan*, about 12 leagues within the iſlands, from whence we had a pilot, who carried us ſafely thither on the 11th of *October*; upon this iſland the *Chineſe* granted us a ſettlement, and liberty of trade, but not to *Ning-po*, which is 6 or 8 hours ſail to the weſtward, and all the way amongſt iſlands; this being the largeſt, is 8 or 9 leagues in length from eaſt to weſt, and 4 or 5 leagues in breadth; about 3 leagues from that point of the main-land, called *Cape Liampo* by the *Portugueſe*, but *Khi-tu* by the *Chineſe*; at the weſt end of this iſland is the harbour, which is very ſafe and convenient, and where the ſhips ride within call of the factory, which is built cloſe upon the ſhore on a low plain valley, with near 200 houſes about it for the benefit of trade; inhabited by men, whoſe jealouſy has not yet ſuffered them to let their wives dwell here; for the town where they are, is 3 quarters of a mile further from the ſhore, ſurrounded with a fine ſtone-wall, about 3 miles in circumference, mounted with 22 ſquare baſtions plac'd at unequal diſtances, beſides 4 great gates, on which are planted a few old iron-guns, ſeldom or never us'd; the houſes within the wall are very meanly built; here the *Chumpeen*, or governour of the iſland lives, and between 3 or 4000 beggarly inhabitants, moſtly ſoldiers and fiſhermen; for the trade of this place being newly ſet up, has not yet brought any conſiderable merchants hither; the iſland in general abounds with all ſorts of proviſions, ſuch as cows, buffalo's, goats, deer, wild and tame hogs, geeſe, ducks, hens, rice, wheat, calavances, coleworts, turnips, potatoes, carrots, beets and ſpinage; and as to merchandiſe, there is none, but what comes from *Ning-po*, *Hangcheu*, *Nankin*, and the inland towns; here alſo tea grows in great plenty upon the tops of the hills, but it is not in that eſteem with what grows on more mountainous iſlands; tho' this iſland is pretty well peopled, yet it is far from what it was in F. *Martinius*'s time, when he deſcribes *Cheuxan*; and Dr. *Cunningham* ſuppoſes, that the ſuperſtitious pilgrimages thereto, mention'd by F. *Martinius*, muſt be meant of the iſland *Pou-to*, which lies 9 leagues from hence, and 3 miles to the eaſtward of this iſland; this *Pou-to* is a ſmall iſland, about 5 leagues round, at the eaſt-end whereof is a place famous for the ſuperſtitious

pilgrimages made thither for the ſpace of 1100 years; it is inhabited only by *Bonzes*, to the number of 3000, all of the ſect called *Hoſhang*, or unmarried *Bonzes*, who lead a *Pythagorean* life; and there they have built 400 *Pagodes*, two of which are conſiderable for their largeneſs and finery, having been lately cover'd with green and yellow tiles, brought from the Emperor's palace at *Nankin*, and adorned within with ſtately idols finely carved and gilded, the chief of which is the idol *Quon-em*; to theſe two *Pagodes* belong two chief prieſts, who govern all the reſt, they have ſeveral roads and avenues cut thro' the iſland, ſome of which are paved with flag-ſtones, and ſhaded with trees planted on each ſide; their dwellings are the beſt the Dr. ſaw in thoſe parts, all which are maintain'd by charitable devotions; and the *Junks*, who go from *Ning-po*, and this place to *Japan*, touch there both going and coming, to make their offerings for their good ſucceſs; there is another iſland called *Kim-tong*, five leagues from hence in the way to *Ning-po*, whither, they ſay, ſeveral *Mandarins* retire to live a quiet life, after they have reſigned their employments; on that iſland there are alſo ſaid to be ſilver-mines, but prohibited to be opened; the reſt of the circumjacent iſlands are either deſert, or but poorly inhabited by a few fiſhermen; but all of them are ſtored with abundance of deer; for, it is not long ſince that this iſland of *Chuſan* began to be peopled; it is true, that in *Martinius*'s days, about 50 years ago, it was very populous for the ſpace of three or four years, at which time the fury of the *Tartarian* conqueſt was ſo great, that they left it deſolate, ſparing not ſo much as the mulberry-trees, (for then they made a great deal of raw ſilk here) and in this condition it continued till about 18 years ago, that the walls of the preſent fort, or town, were built by the governor *Ting-hai*, as a garriſon to expel ſome pirates, who had taken ſhelter here; about 14 years ago, the iſland beginning to be peopled, there was a *Chumpeen*, or general, ſent to govern it for three years, to whom ſucceeded the late *Chumpeen*, (who procured the opening of this port to ſtrangers) whoſe government continued till *April* 1701, being tranſlated to be *Chumpeen* of *Tien-cinq Wei* near to *Pekin*, and was ſucceeded by the preſent *Chumpeen*, who is ſon to the old *Chunkoon* of *Emuy*.

They have no other arts or manufactures here, than making of lacker'd ware; they begin to plant mulberry-trees, to breed up worms for the production of raw ſilk; and they make ſome tea, but chiefly for their own uſe; the three ſorts of tea, com-

commonly carried to *England* are all from the ſame plant, only the ſeaſon of the year, and the ſoil make the difference; the *Bohea*, or *Voiii*, ſo call'd from ſome mountains in the province of *Fokien*, where it is chiefly made, is the very firſt bud, gather'd in the beginning of *March*, and dried in the ſhade; the *Bing* tea is the ſecond growth in *April*; and *Singlo* the laſt in *May*, and *June*, both dried a little in tatches, or pans over the fire; the tea ſhrub, being an ever-green, is in flower from *October* to *January*, and the ſeed is ripe in *September* and *October* following, ſo that a perſon may gather both flowers and ſeed at the ſame time; but for one ſeed that is freſh and full, there are 100 bad; theſe make up the two ſorts of fruit in *Le Compte*'s deſcription of tea; as for his other ſort, which he calls ſlymic peaſe, they are nothing but the young buds of the flowers not yet open; its ſeed-veſſels are really tri-capſular, each *Capſula* or caſe containing one nut, or ſeed; and tho' only one or two *Capſula* come to perfection, yet the veſtiges of the reſt may be diſcern'd; in ſeveral places of this iſland it grows without any culture, in a dry gravelly ſoil, on the ſides of hills: *Le Compte* is miſtaken in ſaying p. 96. that the *Chineſe* are entirely ſtrangers to the art of grafting; for Dr. *Cunningham* has ſeen a great many of his paradoxical tallow-trees grafted here, beſides ſome other trees; when they graft they do not ſlit the ſtock as we do, but cut a ſmall ſlice off the outſide of the ſtock, to which they apply the graft, being cut ſloping on one ſide, to correſpond with the ſtock, and bringing up the bark of the ſlice upon the outſide of the graft; they tie all together, and cover it with ſtraw, and mud, as we do. The commentator on *Magalhen* ſeems to be doubtful as to the length of the *Chineſe Che*, or cubit; here they have two ſorts, one of 13 $\frac{7}{10}$ *Engliſh* inches, which the merchants commonly uſe; the other is 11 inches, which is us'd by carpenters, as alſo in geographical meaſures; tho' F. *Martinius* is cenſur'd by F. *Magalhen* for ſpelling a great many *Chineſe* words with *g*, which the *Portugueſe*, and others have done with *m*; yet, his way is more agreeable to the *Engliſh* pronunciation, only that in ſome words the *g* may be left out, as in *Pekin*, *Nankin*, &c.

Dr. *Cunningham* having made an enquiry about *Martinius*'s account of ſowing their fields at *Venchen* with oiſter-ſhells, in order to make new ones grow up; the Doctor was told, that after they have taken out the fiſh, they ſprinkle the ſhells with urine; then putting them into the water again,

new

new oisters grew upon the aforesaid shells; *Martinius* says, he could never find a *Latin* name for the *Fula Magorin* of the *Portugueſe*; but the Dr. is sure that it is the same with the *Syringa Arabica flore pleno albo* in *Parkinſon*; he also says, that the *Kieu-yeu* or tallow-tree bears a white flower like a cherry-tree; but all that the Dr. saw here bore a spike of small yellow flowers like the *Julus* of a *Salix*; the bean, or *Mandarin-broth*, so frequently mention'd in the *Dutch* embassy, and other authors, is only an emulsion made of the seed of *Seſamum*, and hot water; their chief employments here are fishing and agriculture; in fishing they use several sorts of nets and lines as we do; but because they have large banks of mud in some places, the fishermen, in order to go the more easily thereon, have contriv'd a small frame about 3 or 4 foot long, not much larger than a hen-trough, a little elevated at each end, in which he rests upon one knee, leaning his arms upon a cross stick, rais'd as high as his breast, and putting out the other foot often upon the mud, he pushes forwards his frame thereon, and so carries himself along in it; as to their agriculture, all their fields, (where any thing is planted) whether high or low, are divided into such plots, as may retain the water on them, when they please; they plough up their ground with one buffalo, or one cow; they prepare the fields very well, where they are to sow rice, by clearing it of all manner of weeds, moistening it to a pulp; and smoothing it with a frame drawn a-cross; on which they sow the rice very thick, and cover it only with water for 2 or 3 inches high; and when it has grown 6 or 8 inches long, they pull it up by the roots, and transplant it, by tufts in a streight line, into those fields overflown with water; and where a field is subject to weeds, when the water dries up, they prevent their growth, by overturning the mud with their hands in the interstices where the rice is planted; when they sow wheat, barley, pulse, and other grain, they grub up some superficial soil, grass, and roots, and burn all together with some straw; this soil being sifted fine, they mix with the seed, which they sow in holes made in a streight line, and so it grows up in tufts, as the rice does, the field being divided into beds, and harrow'd over, both before, and after the seed is sown; this makes them somewhat resemble garden-grounds; tho' they meliorate their fields, where they sow rice, only by letting the water on them; yet, for other grain, where the ground requires it, they make much use of dung, human excrement, ashes, *&c.* In watering their fields here, they use the

the ſame inſtrument, as that mention'd by *Martinius* in the preface to his *Atlas*, being all of wood, and the contrivance the ſame with that of a chain-pump: Their method of making of ſalt is thus; all the ſhores here being mud, inſtead of ſand; in the ſummer-ſeaſon they pare off the ſuperficial ſoil, which has been overflown with ſalt-water, and lay it up in heaps; when they are to uſe it, they dry it in the ſun, rubbing it fine; then digging a pit, they cover the bottom thereof with ſtraw, at which thro' the ſides of the pit, they paſs a hollow cane, that leads into a jar, which ſtands below the level of the bottom of the pit; they fill the pits almoſt full with the aforeſaid ſoil, and pour ſalt-water thereon, till it is cover'd 2 or three inches high, and this drains thro' into the ſaid jar, and is afterwards boil'd into ſalt.

Dr. *Cunningham* ſaw here a root call'd *Hu-chu-u*, which he takes to be the ſame with that brought from *China* by F. *Fontaney*; to which the natives aſcribe wonderful properties, as that of prolonging life, turning grey hairs into black, by drinking its infuſion for ſome time; inſomuch, that they ſay, it is to be valu'd from 10 to a 1000, or 2000 *Tael* a ſingle root; for, the larger it is, the greater is its value, and efficacy; it is mention'd in *Clyer*'s *Medicina Sinica* N° 84, under the name of *Hoxeu-u*, according to the *Portugueſe* orthography. The ſtory of its diſcovery is this; once upon a time a certain perſon going a ſimpling upon the mountains, by accident fell into ſuch a deep valley, that he could by no means get out again; whereupon looking about for ſomewhat to ſuſtain his life, in this melancholy condition, he eſpied this root, of which he made trial; and he found that in eating thereof, it ſerv'd him both for proviſions and cloathing, by keeping his body in ſuch a temperature, that the injuries of the weather had no influence upon him, during his ſtay there, which was ſome hundred of years; till at laſt, an earth-quake happen'd in that place, whereby the mountains were rent, and he found out a paſſage to his houſe, from whence he had been ſo long abſent; but the ſeveral alterations, that happen'd there in ſuch a ſpace of time, would not permit them to give credit to his ſtory; till conſulting the annals of their family, which gave an account of one of them loſt at that time, they were confirm'd in the truth of his relation.

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The internal Uſe of Cantharides; *by Mr.* Yonge. Phil. Tranſ. N° 280. p. 1210.

A Gentlewoman 54 years old, who for a long time had been mightily afflicted with frequent fits of the ſtone, and commonly brought away ſeveral ſtones with the gravel, &c. grew dropſical, of which being cur'd, ſhe fell into a total ſuppreſſion of urine, which for ſeveral days baffled all remedies; in this deſperate condition, about 4 in the afternoon, on the 5th day of the diſeaſe Mr. *Yonge* gave her 5 *Cantharides*, (without heads, wings, or legs) that weigh'd 4 grains and a half; and with as much camphire, and a little conſerve, he made them into 2 pills, or bolus's; next morning Mr. *Yonge* found no effect, either good or bad; but about noon, the flood came, and continu'd above 48 hours, bringing off in that time much more urine, than could have been expected from her during all the time of the obſtruction; there came away ſome gravel, and ſabulous matter, but no ſtones; nor was the ſtomach, bladder, or other bowels affected as uſual, upon the internal uſe of thoſe inſects; but they operated ſo quietly, as if only two doſes of *Sal Prunellæ* had been adminiſter'd: In ſeveral caſes Mr. *Yonge*, had often given it with ſucceſs, and that without the *Dyſuria*, and other painful accidents, which attend the internal (oftentimes the external) uſe of this medicine; tho' he mix'd no camphire therewith; only waſhing it down with large draughts of poſſet, ptiſan, emulſions, or water-gruel, which in the lady's caſe he forbore, becauſe of her dropſical diſpoſition, and only us'd a draught or two of middling ale, impregnated with broom, juniper-berries, *Daucus* ſeeds, &c. The form in which he was wont to adminiſter it, was that of a ſoft pill or bolus, compos'd of 3 *Cantharides preparat. Troch. é Myrrhâ.* ℈ſs; *Sem. Ammeos gr.* vi *Rob. Cynosb. q. ſ.* This is very ſerviceable in ſtubborn ſuppreſſions of the *Lochia & Menſtrua*, in difficult child-birth, and retention of the *Secundines*; what heat, or pain it cauſes in the neck of the bladder, is much ſhort of what proceeds from applying an epiſpaſtic to the back.

A young man gave a girl a plumb-cake, wherein powder'd *Cantharides* had been mix'd; ſhe eat part of it, and gave three others of the family where ſhe liv'd, a ſhare; they were ſoon afflicted with a burning in the ſtomach, bloody, and ſcalding urine, and great pain in the back; Mr. *Yonge* cur'd them

them all in a ſhort time with powder of *Ammeos* and *Sal Prunellæ*, and emulſions of *Aq. Sperm. Ran.* &c. and by a piece of the cake that remained, Mr. *Yonge* ſuppoſed that 8 or 9 grains of the *Cantharides* muſt have fallen to the ſhare of each.

Olaus Borrichius Act. Med. Barthol. Vol. 4. *Obſ.* 80. gives a chemical and microſcopical *Examen* of theſe flies; he ſays, that their parts, ſeparated by chemiſtry, do not affect the ſkin; that the points of their particles wound it; and that the volatile ſalt inſinuates thro' thoſe little perforations; he alſo attempts to ſhew how they cauſe a *Dyſuria*, and offend the bladder, when applied to a part ſo remote, as the back or neck. *Vide Vol.* 5. *Obſ.* 89.

Experiments on Vegetation; *by Mr.* Abraham de la Pryme. Phil. Tranſ. N° 281. p. 1214.

SOME have made experiments of the meliorating, fertilizing, and multiplying of grain, by ſteeping them in divers liquors; *Digby* mentions a barley-plant ariſing from a ſingle grain, which, by ſteeping and watering it with ſalt-petre diſſolved in common water, produced 249 ſtalks, and above 18000 grains; and the laſt edition of *Cambden* mentions a thing very obſervable, that the corn ſown in a field in *Cornwal*, after a great battle in the time of the civil war, produc'd four or five ears on each ſtalk.

On the 22d of *March* 1699, Mr. *de la Pryme* laid to ſteep in brimſtone-water, a pea, a barley, and a wheat-corn; in allum-water a pea, a wheat, a barley, and an oat-corn; and the ſame in an old ſolution of ſalt of tartar; in the *Caput Mortuum* of *Sal Armoniac* diſſolved in urine; in a ſolution of the ſalt of walls; in a ſolution of ſalt-petre; in a ſolution of *Noſtoc*, or ſtar-gelly, and in urine; having ſteeped them thus for five days and five nights, he ſet them in a good ſoil in a garden, againſt a north-wall, full in the ſun; on the 27th of the ſame month, after a rainy night, together with a pea, a wheat, a barley, and an oat-corn unſteep'd; upon the 10th of *April* following, he found that ſome were juſt come up, and others not; the pea, barley, and wheat ſteeped in brimſtone-water came all up together; the pea ſteeped in allum-water was very big, and ſwelled, but did not ſo much as ſprout; but the barley, wheat, and oat corns were above ground; the pea ſteeped in the old ſolution of ſalt of tartar was half come up, the wheat ſcarcely ſprouted, but the barley and the oat corns

were quite up; the pea, the wheat, the barley, and the oat corns ſteeped in the *Caput Mortuum* of *Sal Armoniac* diſſolved in urine, were all up together; as alſo the next row, that were ſteeped in the ſolution of the ſalt of walls; the pea and the wheat ſteep'd in the ſolution of ſalt-petre were about half up, but the barley and oat corns were quite up; none of thoſe, which were ſteep'd in *Noſtoc*, were come up, nor ſcarcely ſprouted; the barley and oat grains ſteep'd in urine were come up, but the pea and wheat were ſcarcely ſprouted; and to Mr. *de la Pryme*'s ſurpriſe, the pea, wheat, barley, and oat-corns, that had not been ſteep'd at all, were as ſoon up as any of the former; excepting only the wheat, which was about half up; he had ſet them all about a finger deep in the ground, and all the time of their growing there was very fine weather: From all which Mr. *de la Pryme* ſuppoſes, that alum-water is contrary to the nature of peas, and retards their growth, but agrees well enough with wheat, barley, and oats; that the ſolution of ſalt of tartar is not agreeable to the nature either of peas or wheat, but to that of oats and barley; that the ſolution of ſaltpetre had not any of the great virtue he ſuppoſed it to have, *&c.* and that theſe ſteepings did not forward any of the ſaid grains in their growth and coming up, but plainly retarded ſome, or moſt of them; then, Mr. *de la Pryme* dug all of them up, except three ſpires of barley, which he let ſtand about a foot and a half, or two foot from each other, and they grew and increaſed ſo exceedingly, that they had 60, 65, and 67 ſtalks a-piece, from a ſingle grain and root, with every one an ear, and about 40, or ſomewhat more corns a-piece in them; which increaſe proceeded not ſo much, perhaps, from the grain having been ſteep'd in any liquor, as from the fertility and goodneſs of the ſoil, and their competent diſtance from each other; he obſerv'd, that new ſhoots ſtruck up continually from the root; and that, as in the *Eaſt* and *Weſt-Indies*, there are trees that always bear bloſſoms and flowers, green and ripe fruit at the ſame time; ſo here, if the invigorating heat of the ſun had not been cool'd, and weaken'd by the approach of the winter ſeaſon, there conſtantly would have been new and ripe corn, as alſo, empty ears on the ſame root.

The Influence of Reſpiration *on the* Motion *of the* Heart; *by Dr.* Drake. Phil. Tranſ. N° 281. p. 1217.

THE learned Dr. *Lower* has ſo well accounted for the *Syſtole*, or contraction of the heart from its mechanical ſtructure, that he ſeems almoſt to have exhauſted the ſubject; and had he been as happy in diſcovering the true cauſe of the *Diaſtole*, he had left little room for the induſtry and ſagacity of others about this *Viſcus*; he aſcribes the *Diaſtole* to a motion of reſtitution, which is not ſatisfactory; becauſe, the *Syſtole* being the proper, and as Dr. *Lower* himſelf confeſſes, the only motion of the heart, a ſtate of contraction ſeems to be its natural ſtate; and conſequently, without ſome external violence, it would have no *Diaſtole* at all; this will appear more plain, if we conſider the circumſtance thereof, and its motion, as a muſcle, with reſpect to other muſcles: That contraction is the proper action and ſtate of all the muſcles, is evident from experience, as well as from reaſon; for, if any muſcle is freed from the power of its antagoniſt, it is immediately contracted, and is not to be reduced to a ſtate of extenſion by any action whatever of the will or ſpirits; thus, if the *Muſculi Flexores* of any joint be divided, the *Extenſores* of that joint being by that means freed from the contrary action of their antagoniſts, that joint is immediately extended, without any conſent of the will, and in that ſtate it remains; and *vice verſa*, if the *Extenſores* are divided; from whence it is plain, that the muſcles have no reſtitutive motion, but what they derive from the action of their antagoniſts, by which they are balanced; thus likewiſe, the *Sphincters* of the *Gula*, *Anus*, and *Veſica*, having no proper antagoniſts, are always in a ſtate of contraction, and ſuffer nothing to paſs them, but what is forc'd thro' them by the contrary action of ſome ſtronger muſcles, which, tho' they are not properly to be call'd antagoniſts, yet, on all neceſſary occaſions perform the office of ſuch.

That the heart is a muſcle, furniſhed and provided for motion, like other muſcles, is demonſtrated beyond contradiction by Dr. *Lower*, and others; and, as it is a ſolitary muſcle, without any proper antagoniſt, and not directly under the power of the will, nor exerciſing a voluntary motion, it approaches neareſt to the *Sphincter* kind, which has only theſe conditions in common with it; but, in conſtant and regular alternations of contraction and extenſion, it differs exceedingly

from all the muſcles of the body; this reciprocal *Æſtus* of the heart has given the learn'd abundance of trouble, who, finding nothing peculiar in the ſtructure, which ſhould neceſſarily occaſion it, nor any antagoniſt, whoſe re-action ſhould produce it, have been extremely perplex'd to find out the cauſe thereof: Dr. *Drake* obſerves, that Dr. *Lower*'s account of the *Syſtole*, however ſolid and ingenious, has ſomething deficient therein, and his hypotheſis of the *Diaſtole* he takes to be precarious and falſe; for, this author, having by ſound arguments, drawn from the ſtructure and mechaniſm of the heart, eſtabliſhed the certainty of its muſcular motion, takes no notice of any aſſiſtance that the heart receives from any other part; excepting, from the brain, by means of the 8th pair of nerves: The accurate *Borelli*, in his *Oeconomia Animalis*, computes the motive power of the machine of the heart to be equal to, or to ſurmount that of a weight of 3000 pounds; the obſtacles to the motion of the blood thro' the arteries, he eſtimates to be equivalent to 180,000 pounds, which is 60 times as much as he rates the force of the heart at; then deducting 45,000 pounds, for the adventitious help of the muſcular elaſtic coat of the arteries, he leaves the heart with a force of 3000 pounds to overcome a reſiſtance of 135,000 pounds; that is, with 1 to remove 45; this ſtupendous effect, he contents himſelf to aſcribe to the energy of percuſſion; but, had he proceeded in his calculations to the veins, which he allows to contain conſtantly a quantity of blood, quadruple to the contents of the arteries, and to which this energy of percuſſion does either not reach at all, or but very languidly, he probably might have ſeen a neceſſity for ſome other expedient to remove ſo inſuperable a difficulty; this account Dr. *Drake* has taken notice of, purely for the ſake of the calculation, which may be of uſe in the ſequel, the account itſelf being in other reſpects more defective than Dr. *Lower*'s, to which we will return.

The Dr. appears to have overlook'd ſomething of very great moment and importance in the explication of the action of the heart; for, tho' it ſhould be granted, that the muſcular fibres of the heart acted by the nerves, are the immediate inſtruments of its conſtriction and *Syſtole*; yet, it muſt not be denied, that the intercoſtal muſcles and diaphragm are of great ſervice to aid, and facilitate this contraction, by opening a paſſage for the blood thro' the lungs; which if denied, it would be an invincible obſtacle; nor do they promote it that way only; the manner how they farther aſſiſt the heart in its contraction, will

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appear manifeſtly, if we conſider the different poſition, ſituation, and capacity of the blood-veſſels of the lungs in the ſeveral times of elevation and depreſſion of the *Coſtæ*; the pulmonary artery riſes from the right ventricle of the heart, and runs in one trunk, till it comes to the *Aſpera Arteria*, where it is divided, and ſends a branch along with each diviſion of the *Aſpera Arteria*, according to all the minuteſt ſubdiviſions thereof, accompanying all the *Bronchia*, in their whole progreſs thro' the lungs; the pulmonary vein, which empties itſelf into the left ventricle of the heart, ſpreads itſelf on the *Aſpera Arteria* and *Bronchia*, in the ſame manner that the artery does; the neceſſary conſequence of which diſpoſition is, that this artery and vein being co-extended with, and faſten'd to the *Bronchia*, muſt needs ſuffer ſuch alteration of its ſuperficial dimenſions, as the *Bronchia* do in the elevation or depreſſion of the *Coſtæ*; while the ribs are in a ſtate of depreſſion (whether before or after a communication with the external air) the annular cartilages of the *Bronchia* ſhrink into each other, and by that means their dimenſions are exceedingly contracted; in a conformity with this condition of the *Bronchia*, the pulmonary artery and vein muſt alſo, either by means of their muſcular coats, contract themſelves to the ſame dimenſions, or lie in folds or corrugations, which is leſs probable; on the other hand, when the ribs are elevated, and the diaphragm bears downwards, the air ruſhing into the lungs, extends the cartilaginous rings, and divaricates the branches of the *Trachea*, and thereby extends and divaricates the ſeveral diviſions of the pulmonary artery and vein, and ſo lengthens and enlarges their cavities; which enlarging is very conſiderable, not only upon the account of the addition, which they receive in length thereby, but alſo upon account of their divarication; for when the ribs are depreſt, and the lungs ſubſide, the blood-veſſels are not only contracted (as has been already obſerv'd) but their branches, which are exceeding numerous, approach to each other, and lie in a juxta-poſition, by which their cavities are very much compreſſed and ſtreighten'd; but when the ribs are elevated, and the lungs turgid with air, not only the fibres, by which their coats in the oppoſite ſtate were contracted, are extended; but thoſe innumerable veſſels, which, lying before in lines almoſt parallel, compreſſed each other, and making an acute angle at their junctures, are divaricated, and ſeparated from each other, and make an obtuſe angle, whereby their channels are widened; thus a paſſage is open'd to the blood, from the right ventricle of the heart

heart to the left, thro' the lungs, to which it could not otherwiſe be conveyed; and the oppoſition, which the blood contained in that ventricle, muſt otherwiſe have neceſſarily made to its conſtriction, is taken off, and the *Syſtole* thereby facilitated; nor is that all, for, the *Diaſtole* being cauſed (as ſhall be ſhewn in the ſequel) by the force of the blood ruſhing into the ventricles; this ampliation and extenſion of the pulmonary artery is a ſort of check, or counterpoiſe to it, and prevents an endeavour towards two contrary actions at once, which muſt neceſſarily fruſtrate both; for, the heart being an elaſtic, compreſſible body, whoſe proper action, which is contraction, depends on the influx of certain fluids into its fibres, or ſubſtance; and beſides, containing a fluid in its ventricles, or large cavities, in one of which is the mouth of this artery, the action of this veſſel muſt in a great meaſure reſemble that of a *Syringe*, whoſe extremity is immerſed in water; the enlargement, or expanſion of the channels of the artery, anſwering the drawing of the *Embolus*, as the conſtrictive motion of the muſcle of the heart does the preſſure of the atmoſphere upon the ſurface of the water; the one making way for the fluid, and the other forcing it to follow, where the reſiſtance is leaſt; in this ſenſe we may allow a ſort of attraction to the pulmonary artery, entirely depending upon the action of the intercoſtal muſcles and diaphragm; which therefore, we muſt confeſs to be very ſerviceable and inſtrumental in promoting the *Syſtole* of the heart: But, if this author has not obſerved all the mechaniſm and contrivance of nature for the *Syſtole*, or contraction of the heart, much leſs, has he ſufficiently accounted for its *Diaſtole*, or dilatation; which he aſcribes to a motion of reſtitution of the over-ſtrain'd fibres, which, yet, he confeſſes are deſigned for conſtriction only; it is true, he immediately after joins the influx of the blood, as a concurrent cauſe; but, from the ſlight notice he takes of it, it is plain, that he did not ſo much as dream of any great ſhare it had in that action, as appears from his own words *De Corde*, *p.* 75. —— 'But, ſays he, (to 'obſerve this by the bye) ſeeing the motion of the heart is per-'form'd by contraction, and that its fibres are deſigned for con-'ſtriction only; it alſo appears, that it wholly conſiſts in the '*Syſtole*; and therefore, as ſoon as that force is taken off, whereby 'theſe fibres are over-ſtrained in every conſtriction, the heart is 'again relaxed, as it were, by a motion of reſtitution, and 'diſtended by the influx of the blood into its veins; for the '*Diaſtole* ſucceeding by equal intervals, and with an equal force 'can be owing to no motion of the heart, but what either

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'ſlackens its tenſion, or from the influx of the blood:' But, if contraction be the ſole action of theſe fibres (as Dr. *Lower* confeſſes) and as indeed, it is of all muſcular fibres, how came he to fall into ſuch an abſurdity, as to call their diſtenſion (vulgarly, but improperly called their relaxation) a motion of reſtitution? For, from the nature of thoſe fibres, and their diſpoſition in the ſtructure of the heart, the natural ſtate thereof appears plainly to be tonical, and its dilatation a ſtate of violence; and conſequently, the conſtriction is the true motion of reſtitution, and the ſtate to which it will ſpontaneouſly return, when the force is taken off, which is the office of the intercoſtal muſcles and diaphragm: Thus, we are ſtill left to ſeek for the true cauſe of the *Diaſtole*, which ſeems to Dr. *Drake* to be the main, and moſt difficult phænomenon relating to the heart, and the circulation of the blood: But Mr. *Cowper*, in his *Anatomy of Human Bodies*, has further proſecuted and improved, the ſhare, Dr. *Lower* hints, the blood has in that action, ſo as to make it the main inſtrument of the dilatation of the heart, wherein Dr. *Drake* agrees entirely with him; tho' he cannot be ſo entirely of the ſame opinion as to the manner, and reaſons of its being ſo very inſtrumental; 'The heart, ſays Mr. *Cowper*, of 'an animal, bears a great analogy to the pendulums of artificial '*Automata*, as clocks and watches, whilſt its motion is per-'form'd like that of other muſcles, the blood doing the office of 'a *Pondus*:' By the blood doing the office of a *Pondus*, Dr. *Drake* ſuppoſes, that Mr. *Cowper* means, the blood contributes in the ſame manner to the motion of the heart, as the weights do to that of the pendulum of a clock; if ſo, the blood, according to him, muſt be the inſtrument of conſtriction; and dilatation muſt be the natural ſtate, or the ſpontaneous motion, to which it would, when under no violence return; the contrary of which will hereafter appear: But, if he means, that the blood in its reflux, by gravitating on the auricles and ventricles, dilates and expands them, acting therein, as a counterpoiſe to its contraction as a muſcle; Dr. *Drake* could wiſh, Mr. *Cowper* had not confined himſelf to ſo narrow a compaſs, but had given us an explication at large of ſo abſtruſe, and ſo important a phænomenon; becauſe, the ſpecific gravity of the blood ſeems to Dr. *Drake* a cauſe by no means alone adequate to the effect, which it is here ſuppoſed to produce; for, if the blood acts only as a weight by mere gravitation, then that portion of it only, which deſcends from the parts above the heart, can be employed in that action; this, at the largeſt computation, cannot amount to 5 pounds weight,

weight, and muſt, according to *Borelli*'s computation, move a machine, that is able to overcome a reſiſtance of 135,000 pounds; and after making a reaſonable deduction, the Dr. is ſatisfied, that it is not to be effected in the leaſt by ſo ſmall a weight; but neither does the refluent blood gravitate in any ſuch proportion, as the Dr. has here aſſigned; for, to make a true eſtimate of its gravitation, we muſt conſider the circumſtances of the liquor ſuppoſed to gravitate; in which, it very much reſembles water incloſed in a re-curve tube; which, if the length of both its legs be equal when full of water, it may be ſuſpended in the air, with its extremities downwards, without loſing a drop, tho' the diameter of thoſe legs ſhould be very unequal; the caſe of the arteries and veins is pretty nearly ſimilar to a tube ſo filled and inverted; for, if the arteries and veins be continued tubes, (as they appear by a microſcope) then ſuppoſing their contents to have no other determination of motion, than their own weight would give them, the contained fluids muſt be counterpoiſes to each other; for, the veins and arteries being joined at the ſmaller extremities, and the larger of either terminating in the ſame parallel line, it is impoſſible, according to the laws of hydroſtatics, that the contents of one ſhould over-balance the other; how far then, muſt it fall ſhort of forcing the natural power and reſiſtance of ſo ſtrong a muſcle as the heart, by mere gravitation; the blood indeed, has a progreſſive motion thro' its veſſels, wherein it differs from water in a re-curve tube, in the experiment above-ſtated; but, if the natural gravitation of the blood contributes nothing to the dilatation of the heart, this progreſſive motion will be found more inſufficient; for, as this motion is entirely derived from the conſtriction of the heart (as all accounts hitherto derive it) could the blood be ſuppoſed to re-act upon the heart, with all the force impreſſed upon it at firſt by the heart, it would be inſufficient; unleſs we ſuppoſe the force communicated to be ſuperior to the power communicant, which is abſurd; but when the juſt and neceſſary deductions for the impediments, which the blood meets with in its progreſs thro' the veſſels, ſhall be made, the remaining force will be found ſo exceeding weak, that to force the blood thro' the veins may alone be a taſk too great for ſo ſmall a power, without charging it with the additional difficulty of forcing the muſcles of the heart: *Borelli* calculates the force of the heart and the muſcular coat of the arteries, to be together equal to a weight of 3750 pounds, and he allots them a reſiſtance equal to 180,000 pounds, to overcome which, is as 45 to 1; and to make up for a diſproportion, he

he flings into the ſcale the additional force of percuſſion, which he leaves indefinite, and thinks ſufficient to force any quieſcent finite reſiſtance whatſoever; ſuppoſing then the force of the heart, and of the muſcular coat of the arteries, as likewiſe of the reſiſtance, which they muſt overcome, to be computed with any degree of accuracy, there ſtill remains ſuch a prodigious diſproportion to be accounted for, as requires ſome more powerful agent, than any yet aſſigned, to make up the deficiency: What aſſiſtance the heart receives from the action of the *Thorax*, towards facilitating its contraction, without which there could have been no *Syſtole*, has been already ſhewn; but, neither the intercoſtal muſcles or diaphragm, which are ſo inſtrumental in that part of its action, can contribute any thing to the *Diaſtole*; becauſe, they ſerve only to enlarge the cavity of the *Thorax*, and thereby open a paſſage to the blood from the heart, and promote its conſtriction: Whatever, therefore, the force is, that dilates the heart, and is the cauſe of the *Diaſtole*, it muſt be equal to that of the heart, the intercoſtal muſcles, and diaphragm, to all which it acts as an antagoniſt; without taking into the account the *Serratus major anticus*, and other muſcles, which have an obſcure ſhare in the elevation of the *Coſtæ*; becauſe ſo much may reaſonably be deducted on account of the *obliquus externus Abdominis*, and other muſcles, which, having their inſertions on ſome of the lower ribs, are as inſtrumental towards their depreſſion, and ſo ballance the account; but the chief uſe of theſe is in violent reſpiration; their ſhare, in ordinary reſpiration, being but ſmall: Such a real power (which may in the leaſt be ſuſpected of any ſhare in this action) is difficult, perhaps, impoſſible to be found in the machine of any animal body; and yet, without ſome ſuch antagoniſt, it is as impoſſible the circulation of the blood ſhould be carried on; all the engines, hitherto diſcovered within the body, conſpire towards the conſtriction of the heart, which is the ſtate of quieſcence, to which it naturally tends; yet, we find it alternately in a ſtate of violence, that is, of dilatation; and this muſt neceſſarily be ſo, becauſe, upon this alternation depends all animal life; ſome ſufficient external cauſe muſt therefore be found out, to produce this great phænomenon; which cauſe, muſt be either in the air, or atmoſphere, becauſe we have no conſtant and immediate commerce with any other mediums: Some great phyſicians, obſerving this, and that upon being deprived of communication with the external air, we became inſtantly

extinct, have imagin'd, that in the act of inſpiration, certain purer particles of the air are mix'd with the blood in the lungs, and conveyed with it to the heart; where it nouriſh'd a ſort of vital flame, which was the cauſe of this reciprocal *Æſtus* of the heart; others not quite ſo groſs, rejecting an actual flame, have fancied, that theſe fine particles of air, mixing with the blood in the ventricles of the heart, produced an effervescence, which dilated it; but theſe fancies have been long ſince exploded; and it is a point ſtill undetermin'd, whether or not any air at all mixes with the blood in the lungs.

But ſuppoſing, that ſome air may inſinuate itſelf into the pulmonary vein, it can no otherwiſe dilate the heart, than by an effervescence in the left ventricle, which would not dilate the right; but this opinion is contradicted by *Autopſie*, and laboriouſly confuted by others; there remains therefore, only the groſs body of the atmoſphere to be conſider'd, which is undoubtedly, the antagoniſt to all theſe muſcles, which ſerve for ordinary inſpiration, and the conſtriction of the heart; this will appear more evidently, if we conſider not only the power, but the neceſſity of its action upon animal bodies, as well as the want of other ſufficient agents.

The heart is a ſolitary muſcle of very great ſtrength, and the intercoſtal muſcles, and diaphragm, which likewiſe have no antagoniſts, are a vaſt additional force, which muſt be ballanc'd by the contrary action of ſome equivalent power, or other; for tho' the action of the intercoſtal muſcles be voluntary, that does not exempt them from the condition of all other muſcles ſerving for voluntary motion, which would be in a ſtate of perpetual contraction, notwithſtanding any influence of the will, were it not for the libration of antagoniſt muſcles; this libration between other muſcles is anſwered by the weight of the incumbent atmoſphere, which preſſes upon the *Thorax*, and other parts of the body; and, as in all other voluntary motions, the influence of the will only gives a prevalence to one of two powers, before equi-librated; ſo here it ſerves to enable thoſe muſcles to lift up a weight too ponderous for their ſtrength, not ſo aſſiſted; and therefore, as ſoon as that aſſiſtance is withdrawn, the *Coſtæ* are again depreſs'd by the mere gravitation of the atmoſphere, which would otherwiſe remain elevated, thro' the natural tendency of thoſe muſcles to contraction: This is plainly prov'd from the *Torricellian* experiments, and thoſe made upon animals in Mr. *Boyle*'s engine,

gine; where, as ſoon as the air is withdrawn, and the preſſure thereby taken off, the intercoſtal muſcles, and diaphragm are contracted, and the ribs elevated in an inſtant, and cannot by any power of the will be made to ſubſide, till the air is again admitted to bear them forcibly down.

Dr. *Willis* having obſerv'd, that the fibres of the external and internal intercoſtal muſcles ran in a contrary order, as it were, decuſſating each other, takes occaſion from thence to fancy, that there was an oppoſition in their office; and that as the external ſerve to raiſe up the ribs, the internal drew them down again; not conſidering, that when a contractible body is faſten'd at its ſeveral ends to points unequally movable, let the contraction happen in what part, or manner ſoever, the more movable point muſt be drawn towards that, which is leſs movable; by which rule whether the external or internal intercoſtals are contracted, the lower ribs will be forc'd to approach the upper, that is be elevated: As in the elevation of the *Coſtæ*, the blood by the paſſage that is open'd for it, is in a manner ſollicited into the lungs; ſo in their depreſſion, by the ſubſidence of the lungs, and the contraction of the blood veſſels, both which are conſequent thereto, the blood is forcibly driven, as it were with an *Embolus*, thro' the pulmonary vein into the left ventricle of the heart; and this, together with the general compreſſion of the body, by the weight of the atmoſphere, which ſurrounds and preſſes upon its whole ſurface, is that power which cauſes the blood to aſcend, in the veins, after that the force impreſs'd thereon by the heart is broken and ſpent; and which is ſufficient to force the heart from its natural ſtate to a dilatation.

He that can compute the weight of a column of air, equal to the ſurface of the whole body, will readily grant it a power ſufficient for the effects, here aſcribed to it; and when he conſiders, that the bodies of animals are compreſſible machines, he will find, that it muſt neceſſarily affect them, in the manner here laid down; but tho' our bodies be entirely compos'd of *Tubuli*, or veſſels fill'd with fluids, yet this preſſure how great ſoever, being equal, could have no effect upon them, if the ſuperficial dimenſions were not eaſily variable; becauſe, being compreſſed on all parts, with the ſame degree of force, the contain'd fluids could not any where begin to recede, and make way for the reſt to follow, but would remain as fix'd and immovable, as if they were actually ſolid; but by the dilatation of the *Thorax*, room is made for the fluids to move, and

by its co-arctation freſh motion is impreſt, which is the main ſpring, whereby the circulation is ſet, and kept going: This reciprocal dilatation, and contraction of the ſuperficial dimenſions of the body ſeems ſo neceſſary to animal life, that there is not any animal ſo imperfect as to want it, at leaſt, ſo far as our anatomical diſcoveries have yet reach'd; for tho' moſt kinds of fiſh, and inſects, want both movable ribs, and lungs, and conſequently have no dilatable *Thorax*; yet that want is made up to them by an analogous mechaniſm, ſufficiently anſwering the neceſſities of life; thoſe fiſhes, which have no lungs, have gills, which perform the office of lungs, receiving and expelling alternately the water, whereby the blood-veſſels ſuffer the ſame alteration of dimenſions, that they do in the lungs of more perfect animals; the lungs or air-veſſels of inſects are ſtill exceedingly more different in ſtructure, diſtribution, and ſituation from thoſe of perfect animals, than thoſe of fiſhes are; and yet in their uſe, and action perfectly agree with both, that is receiving, and expelling the air, and varying the dimenſions, and capacities of the blood-veſſels; theſe having no *Thorax*, or ſeparate cavity for the heart, and air-veſſels, have the latter diſtributed through the whole trunk of their bodies, by which they communicate with the external air thro' ſeveral *Spiracula*, or vent-holes, to which are faſten'd ſo many little *Tracheæ*, or wind-pipes, which thence ſend their branches to all the muſcles, and *Viſcera*, and ſeem to accompany the blood-veſſels all over the body, as they do in the lungs only of perfect animals; by this diſpoſition, in every inſpiration, the whole body of theſe little animals is inflated, and in every exſpiration compreſs'd; and conſequently, the blood-veſſels muſt ſuffer a viciſſitude of extenſion, and contraction, and a greater motion muſt thereby be impreſs'd upon the fluids contain'd in them, than the heart, (which does not in theſe animals appear to be muſcular) ſeems capable of giving: The only animal that is exempted from this neceſſary condition of breathing, or receiving, and expelling alternately ſome fluid into, and out of the body, is a *Fœtus*; but this, while included in the womb, has little more than a vegetative life, and ought ſcarcely to be reckon'd amongſt the number of animals; for were it not for that ſmall ſhare of muſcular motion, which it exerciſes in the womb, it might without any abſurdity be accounted as a graft upon, or a branch of the mother.

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Concerning the immediate matter, and means of life, and nutrition, authors are not agreed; nor is it the buſineſs of this place to reconcile, or decide their differences, but to account for the motion of the blood thro' the veſſels only: In order to this it will be neceſſary to obſerve, that the pulſation of the heart in a *Fœtus* is ſo very weak and obſcure, and the motion of the blood ſo extremely ſlow and languid, as to be ſcarcely, if at all, perceivable; as has been experienc'd in the diſſection of puppies before reſpiration; to produce ſuch a feeble palpitation, and creeping motion, no greater force ſeems to be requir'd, than may be deriv'd from the communication between the veſſels of the mother, and *Fœtus* in the *Placenta*: Such as reject this communication, uſually do it in favour of one, or both of theſe opinions; *viz.* that the arteries of the *Uterus* depoſite a nutritive juice, or a juice impregnated with air in the *Placenta*, which is ſuck'd in by the umbilical vein and conveyed to the *Fœtus*, for the neceſſary uſes of nutrition and life; now they who patronize either of thoſe opinions lead nature an unneceſſary dance; for if the maternal blood does really contain any ſuch nutritious, or any ſuch neceſſary aerial particles, why ſhould they be ſeparated, and extravaſated, to be with difficulty received into the umbilical vein, and again mix'd with the blood, when they might be more eaſily imparted by the plain ſimple way of transfuſion, from the arteries of the mother to the veins of the *Fœtus*; and that this is the courſe, which nature takes in this caſe, Dr. *Drake* is perſuaded from the eaſineſs, and ſimplicity of the method: They who contend for the conveyance of a nutritious juice, thro' the umbilical vein from the *Placenta*, run into two difficulties, which are next to abſurdities; for firſt, they are oblig'd to make this vein, which like all other veins, ſeems deſign'd for the re-conveyance of blood only, the proper and immediate channel, thro' which a very different liquor is to be conveyed; and in the next place, to give a power of attraction, or ſuction thereto; becauſe the nutritious juice, which it is thus deſtin'd to convey, is both viſcous, and ſtagnant; and has neither force to propel, nor ſubtility to penetrate, or inſinuate itſelf into the capillary veins; and therefore muſt be drawn, or ſuck'd, as milk is from the breaſt; to which the *Placenta*, and its nutritious juice are, by the favourers of theſe opinions, expreſsly compar'd; but if this were the ſole uſe of the *Placenta*, and umbilical veſſels, why were the umbilical arteries ſent along with the vein? Their office is not to bring any thing back to the

the *Fœtus*, nor can they contribute any thing to the benefit of the mother; for the uterine arteries convey all to the *Placenta*; the umbilical vein to the *Fœtus*, and the uterine veins return again the ſur-charge of the mother's blood; the umbilical arteries alone, have nothing to do, and are ſuperfluous, which is contrary to the conſtant practice of nature; yet if *Autopſie* did, in the leaſt countenance this hypotheſis, ſome defence might ſtill be made; but we find in the umbilical vein of a *Fœtus* nothing but florid blood, ſuch as in all probability is receiv'd immediately from the arteries of the mother, without any mixture.

Such as ſupply the body of the *Fœtus* with air from the *Placenta*, are as much diſtreſs'd as the former; for they are oblig'd to beg the queſtion twice, which even when granted, will not anſwer their ends; firſt they ſuppoſe, that an intimate mixture, and confuſion of air with the blood, is neceſſary for the ſupport of animal life, a *Poſtulatum*, which perhaps the former part of this diſcourſe might have render'd unneceſſary; and next that the *Fœtus* is ſupplied with air from, and its blood mixt with it in the *Placenta*; and here again they fetch a compaſs without neceſſity, or proof; for if a mixture of air were neceſſary to a *Fœtus*, why ſhould it be ſeparated from the mother's blood, and not rather communicated both together, ſince it is ſo much more eaſy and commodious; but neither does the *Placenta* ſeem to be provided for the ſeparation of air, but of a much groſſer fluid, deſtin'd to ſome other uſe, which *Autopſie* confirms; yet were both theſe opinions true, they are however defective, and the circular motion of the blood unprovided for: By transfuſion this great phænomenon is naturally accounted for, and the ends, for which the other two hypotheſes were devis'd, might both be anſwer'd with more eaſe; for the hyſteric arteries, tranſmitting their blood immediately to the umbilical vein, may very eaſily tranſmit ſuch nutritious juices, or aerial particles as are contain'd in the blood, along with it, without depoſiting them by the way; by this means, ſo much of the impulſe of the mother's blood is preſerv'd, as ſuffices to maintain that languid circulation, which a *Fœtus* has; for the blood being propell'd thro' the arteries of the *Uterus* into the umbilical vein, is directly conveyed to the *Sinus* of the *Porta*; and thence by a ſhort and direct paſſage thro' the *Cava* to the heart; where paſſing thro' the *Foramen ovale* to the left ventricle, and thro' the *Canalis arterioſus* from the right, and pulmonary artery,

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it is all deliver'd, without coming at the lungs, to the *Aorta*, and from thence again by the umbilical arteries to the veins of the *Uterus*, making a ſort of epicycle to the main circulation in the mother.

As this opinion is favour'd by the ſtructure and diſpoſition of the blood-veſſels on both parts; ſo there is nothing in it difficult to be conceiv'd, or repugnant to experience; later diſcoveries have made it apparent, that the arteries and veins are continu'd tubes; and that the latter contain nothing but what they receive from the former; and there appears no reaſon, why we ſhould ſuppoſe this method to be varied in the *Placenta*; on the other hand, if the arteries of the *Uterus* were continu'd to the veins of the ſame part, and thoſe of the *Fœtus* in like manner without communicating with each other, their confluence in the *Placenta* ſeems to be altogether uſeleſs; and the umbilical arteries and veins fram'd for no other ſervice, or purpoſe, than to give the blood room for an idle ſally: Mr. *Cowper* has re-eſtabliſh'd this old, but long exploded truth; for by pouring mercury into a branch of the uterine artery of a cow, that went into one of the *Cotyledons* of the *Uterus*, he fill'd thoſe branches of the umbilical veins, which went from that *Cotyledon* to the navel of the *Fœtus*: Now it would be a weak objection to alledge that the obſervation, and experiment having been made on the *Uterus* of a cow, the inference would not hold from thence to a woman, the one being glanduliferous, and the other placentiferous; ſince every one of theſe *Cotyledons*, or uterine glands, is in all reſpects a little *Placenta*, and all the difference between them is in number, name, and magnitude; why ruminants differ in this particular, from other viviparous animals, is beſide the ſubject of the preſent enquiry; but the great flux of blood which conſtantly follows upon extracting the *Placenta* from women (which is frequently ſo great, as to coſt them their lives) is as plain a demonſtration to reaſon of the continuity of the veſſels, as Mr. *Cowper*'s experiment is to the eye.

It is objected by ſome, that if there was ſuch a continuity of veſſels, and ſuch a tranſfuſion of blood, the *Fœtus* muſt neceſſarily periſh thro' loſs of blood, upon the ſeparation of the *Placenta* from the *Uterus*; but that on the contrary, no viſible flux of blood enſues, while the *Fœtus* continues wrapt in the membrane, in which condition it may be kept alive ſome hours; to this it may be anſwer'd, that the circulation in the *Fœtus*, being deriv'd from the mother, may be ſuppos'd to ceaſe

ceaſe wholly upon cutting off the communication between them, till it is again more forcibly renew'd by reſpiration: But if we allow that the motion already impreſs'd upon the blood is ſufficient to keep it going a little while, yet it muſt be ſo exceeding languid, that the mere reſiſtance of the external air muſt be more than enough to hinder any efflux of blood from a *Fœtus* before reſpiration; how long life may be preſerv'd, without an actual circulation of the blood, is a queſtion not to be diſcuſs'd at preſent; but we may be convinc'd by ſeveral obſervations and experiments, that life has been recover'd a long time after all ſigns of reſpiration, circulation, or even life itſelf, have diſappear'd; ſo that we cannot think the firſt ſolution either impoſſible, or improbable; it may be further objected, that in the early days of geſtation in viviparous animals, there is no *Placenta*, nor any adheſion of the umbilical veſſels to any part of the *Matrix*, and conſequently no ſuch transfuſion; and that in oviparous animals there is no continuity, or communication of veſſels of any kind, during all the time of incubation; but theſe objections carry neither the weight, nor difficulty along with them that they may be ſuppos'd to do; for in thoſe days there is neither blood nor blood-veſſels, and conſequently there can be no circulation of the blood; and the embryo, of what ſpecies ſoever, is no more than a vegetable at that time; nor does the *Fœtus* of any viviparous animal enjoy any circulation, or ſhew any ſigns of animal life, till after thoſe veſſels, as well as others, requiſite to the circulation, are compleated: It muſt be confeſs'd, that oviparous animals are denied the benefit of this communication; but that deficiency is ſufficiently compenſated by a peculiar mechaniſm, which directly anſwers the end of reſpiration, and the preſſure of the atmoſphere upon the *Fœtus*; there is at the obtuſe extremity of an egg a ſmall cavity, fill'd with air, which is the ſuccedaneous inſtrument to the reſpiratory organs; for as ſoon as the contents begin to be warm'd by the incubation of the hen, or any analogous heat of furnace or dunghill, the ſeveral humours of the egg acquire a fermentative motion; and the air contain'd in the cavity, or veſicle at the obtuſe extremity of the egg is rarified, and the veſicle itſelf extended and enlarged; and conſequently, the other contents are compreſs'd, to which the fermentative motion naturally reſiſts; but both bodies being as well compreſſible as dilatable, and both having an expanſive motion impreſt upon them by incubation, the compreſſion and renitency will

will be mutual, but varied in degree; according as either, by the variation of circumſtances, ſhall prevail; by this means, an alteration of compreſſion and dilatation will be produced in both, anſwering the reſpiratory motion; by which a motion will be communicated, which, as ſoon as the organs, by which it ſhould be regulated, are compleated, will in the body of the *Pullus*, or chick, be regular and circulatory.

Fabritius ab Aquapendente, and after him Dr. *Harvey* have aſſigned divers uſes to this cavity, or air-veſicle; but, tho' Dr. *Drake* cannot agree to that perſpiration, refrigeration, and reſpiration, which they make it the inſtrument of; yet, perhaps, the air, that was incloſed in that cavity, may, thro' the increaſe of the body of the *Pullus*, and its own rarefaction (which is, at laſt ſo great, as to occupy half the ſhell) break the membrane, which ſeparated it from the *Pullus*, and thereby give it ſo much reſpiration, as to form the chirping, which is often heard before the breaking of the ſhell; and therewith give it an addition of ſtrength to enable it to break the ſhell; but, how it ſhould reſpire ſooner, the Dr. cannot conceive: There are ſeveral problems of great ſeeming difficulty, the ſolutions of which flow naturally from what has been here laid down; the Dr. therefore attempts the *Harveyan* problem; *viz. Why a* Fœtus *taken out of the* Uterus *with its membranes entire, ſhall live in water ſome hours without communication with the external air; whereas, if it be taken out, and ſuffer'd once to breathe, it cannot afterwards ſurvive a moment, without the benefit of reſpiration?* Granting the fact to be as Dr. *Harvey* has delivered it, which yet is not ſo in all caſes, the main difficulty is grounded on a miſtake, which from the ſtating of the queſtion this great man ſlipt into; for, he imagines, that a *Fœtus* is ſooner ſuffocated, after having once breathed, than if it had not breathed at all; and that by breathing, it had contracted ſomething, which rendered it more apt to periſh; *Harv. de Gen. Anim. Cap. de Partu*: Dr. *Harvey* obſerving, that a *Fœtus* liv'd longer without reſpiration, and diſpenc'd better with the want of air, while included in the entire membranes, than it could afterwards; infers from thence, that the air does, in the firſt act of inſpiration, impreſs upon the lungs ſome quality, which renders it ever after more indiſpenſably neceſſary; but allowing his obſervation, Dr. *Drake* denies his inference to be good; for, deprive a *Fœtus* of the means of reſpiration, and then take it out of its membranes, and it will be as ſoon ſuffocated as if it had reſpired

before; this proves, that this neceſſity of intercourſe with the air, by the way of the lungs, is not the offspring, but the parent of reſpiration; and, that that learned man was drawn into a fallacy of *Non cauſa pro cauſâ:* The reaſon of this neceſſity is the preſſure of the external air upon the ſurface of the body, from which it was defended by the interpoſition of the membranes, and the humours contained therein, which are not ſo compreſſible, as the body of the *Fœtus* itſelf; therefore, as ſoon as the *Fœtus* is excluded, and expoſed to the immediate contact of the circumambient atmoſphere, the veſſels, and all the cavities of the body muſt neceſſarily be ſo compreſt, that the fluids cannot have room for motion; and conſequently, the *Fœtus* could have no life, if nature had not contrived by the motion of the *Thorax*, to remove and admit that preſſure alternately, and thereby impreſs a motion on the fluids, which is the ſpring of life; but, this motion of the *Thorax* being any way ſuppreſſed, the equal preſſure of the atmoſphere on all parts occaſions a total ceſſation of motion, which is death.

A Pocket-Microſcope; *by Mr.* Wilſon. Phil. Tranſ. N° 281. p. 1241.

THE late improvements, made by magnifying glaſſes, are not ſo much owing to their make, and the compounding of microſcopes, as to the methods of applying objects for the advantage of light; and experience, as well as the authority of Dr. *Hook* in his preface to his *Micrographia*, aſſure us, that ſingle magnifying glaſſes, when they can be uſed, are preferable to microſcopes, compounded of two or more magnifying glaſſes.

Mr. *Wilſon*'s ſett of microſcopes, has eight different magnifying glaſſes; ſeven of which may be uſed, with two different inſtruments, for the better applying them to various objects; one of theſe inſtruments is repreſented in Plate VI. Fig. 1. A A A A, and is made of ivory, it has three thin braſs plates E E, and a ſpring of braſs H within it; to one of the thin plates of braſs is fixed a piece of cork F, with a concavity G..... both in the cork and braſs, to which it is affixed; in one extremity of this inſtrument there is a long ſcrew D, with a glaſs C ſcrewed thereon; in the other extremity there is a hollow ſcrew o o, wherein any of the magnifying glaſſes are ſcrewed, when they are to be made uſe of; the eight different magnifying glaſſes are all ſet in ivory; ſeven of which are ſet in

in the manner of Fig. 2. N° 4; the greateſt magnifier is marked upon the ivory, wherein it is ſet with N° 1, the next N° 2, and ſo on to N° 7; the eighth glaſs is not mark'd, but ſet in the manner of a little barrel-box of ivory, as in Fig. 3.

Fig. 4. *e e* is a flat piece of ivory, whereof there are ſeveral belonging to this ſet of microſcopes, in each of which there are three holes *fff*, wherein three, or more objects are placed between two thin glaſſes, or talks, when it is to be uſed with the greateſt magnifiers.

The inſtrument Fig. 5. is made of braſs, or prince's metal, with joints PPP, to turn eaſily any way, with a ſmall pair of tongs GG, which open at the points *k*, by preſſing together the two heads of the pins II for taking up of objects; there is a round piece of ivory H, ſcrewed upon the other extremity of the tongs, white on one ſide for black and opaque objects, ſuch as are ſeeds or ſands; and black on the other ſide for white objects of that nature; upon the ſharp point A of this braſs inſtrument, all the eight glaſſes, as you ſee in Fig. 2. N° 4, may be fixed; there being a hole in the ivory for that purpoſe, wherein the glaſſes are ſet, with a thin piece of braſs B in the manner of a ſpring, to hold it the firmer; ſo, that when any object is taken up on the points of the tongs *k*, or laid upon the other extremity H, it may be very eaſily applied to the true diſtance of any of the glaſſes, by the help of the joints PPPP, as alſo the ſcrew C, and wheel D, which will bring the object to the exactneſs of the centre or true diſtance, being regulated by a ſpring E.

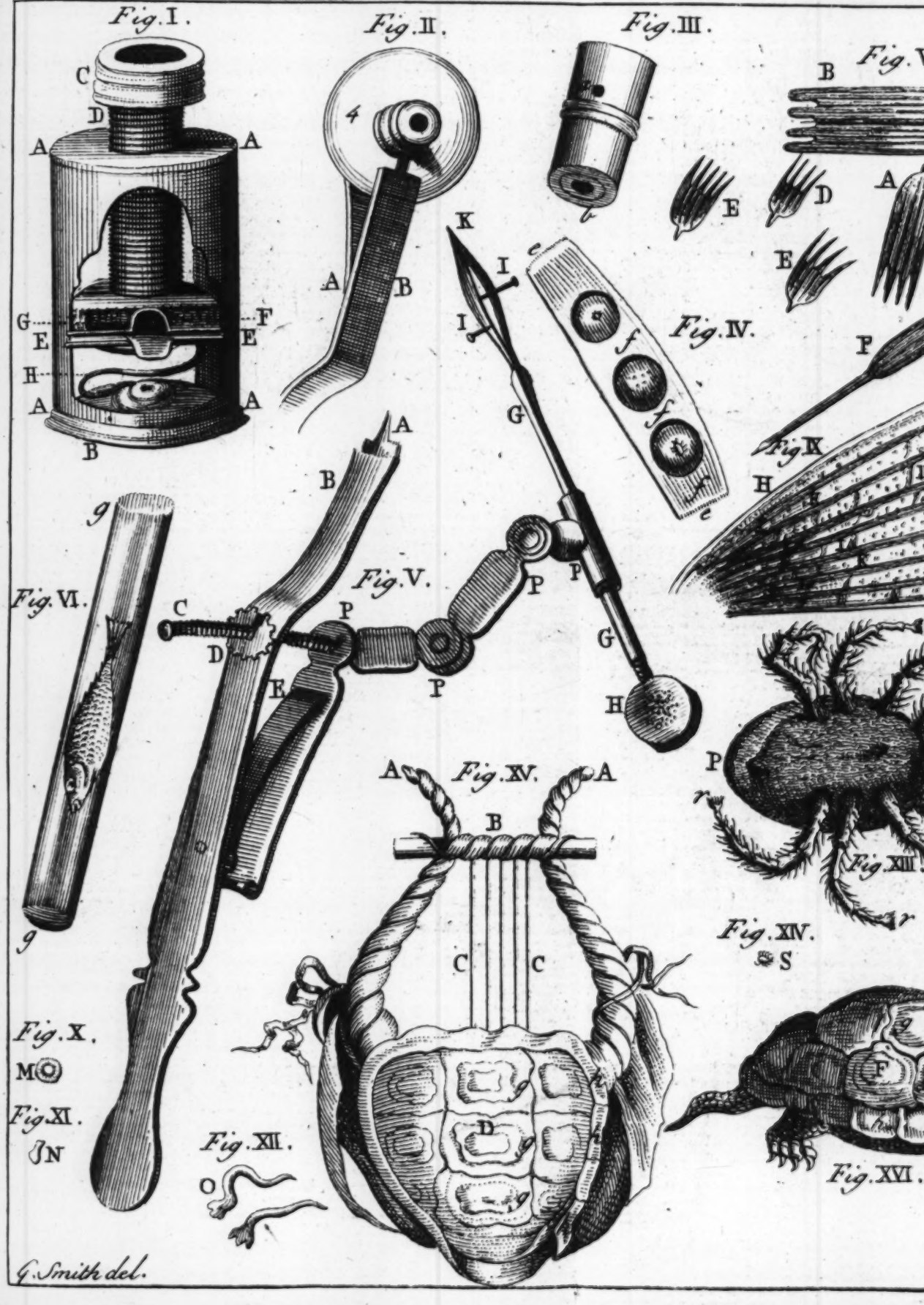
The uſe of the firſt mentioned inſtrument Fig. 1. AAAA is thus; take one of the flat pieces of ivory, or regiſters, as they may be called, *e e* Fig. 4, and ſlide it in betwixt the two thin plates of braſs EE, in the body of the microſcope; ſo, that the object you intend to look upon, may be exactly in the middle, obſerving to put in that ſide of the plate *e e*, where the ring is fartheſt from your eye; then ſcrew into oo, the 3d, 4th, 5th, 6th, and 7th magnifying glaſs; which being done, while you are looking thro' the magnifying glaſs upon the object, you are to ſcrew in, or out, the long ſcrew D in the other extremity of the body of the microſcope, till you bring the object to the true diſtance, which you will find by ſeeing the object clearly and diſtinctly; but, ſince in the greater magnifiers, you can ſee but a ſmall part of the objects, *viz.* the legs or claws of a flea; while you are looking upon any part of the object, if you take hold of the end of the plate *e e*,

whereon the object lies, and move it gently, you may ſee th whole object ſucceſſively, or any part of the object you pleaſe and if that part of the object, you deſign to look upon, be ou of the true diſtance, your end ſcrew D can always bring it in by bringing it nearer, or farther off; after this manner, ma be ſeen all tranſparent objects, duſt, liquids, cryſtals of ſalt ſmall inſects, ſuch as fleas, mites, *&c.* If they be inſects tha will creep away, or ſuch objects as a perſon intends to keep they may be placed between the two regiſter-glaſſes *ff*; for by taking out with the point of a pen-knife the ring that keep in the glaſſes *ff*, where the object lies, they will fall out o themſelves; ſo, you may lay the object between their tw hollow ſides, and put the ring in, as before; but, if the object are duſt, or liquids, a ſmall drop of the liquid, or a little o the duſt laid on the outſide of the glaſs *ff*, and applied a before, will be ſeen very eaſily; as to the 1ſt and 2d magni fying glaſſes, being mark'd with a croſs upon the ivory wherein they are ſet, they are only to be uſed with thoſe regiſter-plates, that are alſo mark'd with a croſs, wherein the objects are placed between two thin talks; becauſe, the thick neſs of the glaſſes in the other regiſters, or plates, hinder the object from approaching to the centre, or true diſtance o theſe great magnifiers; but the manner of uſing them is the ſame with the former; only remember, when you put in, or pull out the ſame plate or regiſter *e e*, whereon the object lies, or move it from one object to another, not to let it rub upon your magnifying glaſs, which is done by opening a little the ſcrew D, when you put in, or take out the plate, or move it from one object to another: For viewing the circulation of the blood at the extremities of the arteries and veins, in the tranſparent parts of fiſhes, eels, *&c.* there are two glaſs tubes, the one bigger, and the other ſmaller, as Fig. 6, wherein the fiſh is to be put; when this leſſer tube is uſed, you are to unſcrew the end-ſcrew D in the body of the microſcope, till the tube *g g* can eaſily enter into that little cavity G of the braſs plate faſtened to the cork F, under the other two thin plates of braſs E E; when the tail of the fiſh lies flat to the glaſs-tube, ſet it oppoſite to your magnifying glaſs; and by ſcrewing in, or out, the end-ſcrew D, you may eaſily bring it to the true diſtance, and ſee the blood circulate; when the larger tube is to be uſed with a larger fiſh, or frog; then you are to take out the braſs plate G F faſtened to the cork, by preſſing down the other two plates E E, and the ſpring H, to

the

whereon the object lies, and move it gently, you may ſee the whole object ſucceſſively, or any part of the object you pleaſe; and if that part of the object, you deſign to look upon, be out of the true diſtance, your end ſcrew D can always bring it in, by bringing it nearer, or farther off; after this manner, may be ſeen all tranſparent objects, duſt, liquids, cryſtals of ſalts, ſmall inſects, ſuch as fleas, mites, *&c.* If they be inſects that will creep away, or ſuch objects as a perſon intends to keep, they may be placed between the two regiſter-glaſſes *ff*; for, by taking out with the point of a pen-knife the ring that keeps in the glaſſes *ff*, where the object lies, they will fall out of themſelves; ſo, you may lay the object between their two hollow ſides, and put the ring in, as before; but, if the objects are duſt, or liquids, a ſmall drop of the liquid, or a little of the duſt laid on the outſide of the glaſs *ff*, and applied as before, will be ſeen very eaſily; as to the 1ſt and 2d magnifying glaſſes, being mark'd with a croſs upon the ivory, wherein they are ſet, they are only to be uſed with thoſe regiſter-plates, that are alſo mark'd with a croſs, wherein the objects are placed between two thin talks; becauſe, the thickneſs of the glaſſes in the other regiſters, or plates, hinders the object from approaching to the centre, or true diſtance of theſe great magnifiers; but the manner of uſing them is the ſame with the former; only remember, when you put in, or pull out the ſame plate or regiſter *e e*, whereon the object lies, or move it from one object to another, not to let it rub upon your magnifying glaſs, which is done by opening a little the ſcrew D, when you put in, or take out the plate, or move it from one object to another: For viewing the circulation of the blood at the extremities of the arteries and veins, in the tranſparent parts of fiſhes, eels, *&c.* there are two glaſs tubes, the one bigger, and the other ſmaller, as Fig. 6, wherein the fiſh is to be put; when this leſſer tube is uſed, you are to unſcrew the end-ſcrew D in the body of the microſcope, till the tube *g g* can eaſily enter into that little cavity G of the braſs plate faſtened to the cork F, under the other two thin plates of braſs E E; when the tail of the fiſh lies flat to the glaſs-tube, ſet it oppoſite to your magnifying glaſs; and by ſcrewing in, or out, the end-ſcrew D, you may eaſily bring it to the true diſtance, and ſee the blood circulate; when the larger tube is to be uſed with a larger fiſh, or frog; then you are to take out the braſs plate G F faſtened to the cork, by preſſing down the other two plates E E, and the ſpring H, to the

PLATE.


Fig. I.
Fig. II.
Fig. III.
Fig. IV.
Fig. V.
Fig. VI.
Fig. X.
Fig. XI.
Fig. XII.
Fig. XIII.
Fig. XIV.
Fig. XV.
Fig. XVI.
G. Smith del.

Hulett Sculp.

the end of the microſcope B; and by turning the cork and braſs-plate GF ſideways, you may eaſily take it out, and put it in again; when the cork-plate GF is out, the larger tube will eaſily enter into the body of the inſtrument, and is to be uſed in the ſame manner with the ſmaller tube. If you would ſee the circulation of the blood in a frog's foot, chuſe ſuch a one as will juſt go into your tube, then with a little ſtick, expand its hinder foot, and apply it cloſe to the ſide of the tube, obſerving, that no part of the frog hinder the light from falling on its foot, and when you have it at the exact diſtance, by means of the ſcrew D, you will ſee the rapid motion of the blood in its veſſels, which are very numerous, in the tranſparent thin membrane that is between the frog's toes; for this object the third and fourth magnifiers will do very well; but you may ſee the circulation in the tails of water-newts with the fifth and ſixth glaſs, becauſe the globules of blood in theſe newts, are as big again as thoſe of the blood of frogs or ſmall fiſh, as Mr. *Cowper* has obſerved Phil. Tranſ. N° 280: Obſerve, that the circulation cannot be ſo well ſeen by the firſt and ſecond magnifiers, becauſe the thickneſs of the glaſs, wherein the fiſh lies, hinders the approximation.

The glaſs placed in the manner of a barrel box Fig. 3. is only to be uſed with the braſs inſtrument, or in the hand, being the leaſt magnifier for larger objects, ſuch as flies and common inſects, &c. the hole *a* in the ſide of this box is to be fix'd on the point A of the braſs-inſtrument, obſerving to put the extremity next your eye and the other to the object; for if you take up any inſect on the point of the tongs *k*, or lay any opaque object on C the other extremity, you may bring them to the true diſtance by the help of the ſcrew, ſpring and joints CDPE: In viewing of objects, eſpecially ſuch as are opaque, you muſt take care not to hinder the light from falling upon them; for nothing can be ſeen with the beſt of glaſſes, unleſs the object be at a due diſtance, and in a ſufficient light; the beſt light for the plates, or regiſters, where the object lies between the two glaſſes, is a clear ſky-light, or where the ſun ſhines upon any white object, or the reflection of the light from a looking-glaſs; the light of a candle is likewiſe good for obſerving the circulation in very ſmall objects, tho' it be a little uneaſy to ſuch as are not convergent in microſcopes, to find out that light: For the conveniency of drawing ſketches, or deſigns after microſcopical objects, Mr. *Wilſon* has made a pedeſtal to fix the two inſtruments above deſcribed upon, and make them ſtationary to any convenient light; this

this pedeſtal may be placed upon a table, &c. and after that the object and light are fix'd, the object may be ſeen without any trouble or difficulty in finding the light.

Fig. 7. A B C D E F repreſent the feathers of the wings of butter-flies and moths; A B, are the ſame, only differently magnified; A as it appeared by the fourth glaſs, and B by the firſt; C D E F were all view'd by the fourth glaſs and were taken from different parts of thoſe inſects.

G Fig. 8. is a grain of the *Farina* of the capilaments of mallows viewed by the firſt glaſs.

H H Fig. 9. is the tail of a ſmall fiſh, view'd when alive by the fourth glaſs; *i i* is that part of the tail next the body of the fiſh, where the trunks of the veins and arteries paſs together; I I I I their extremities which appear united; *k k k* other inoſculations, with the arteries and veins appearing in the tranſparent membrane, between the cartilages K K; L L L L are the cartilages compos'd of ſeveral joints, on each ſide of which, the trunk of a vein and artery paſſes.

M Fig. 10. an *Animalculum*, whereof a great number appeared moving up and down on the tail of the fiſh.

N Fig. 11. repreſents a ſide-view of the ſame *Animalculum*.

O Fig. 12. is another *Animalculum* of a different figure from the former, that ſtuck to the tail of the fiſh by its jagged extremity, and frequently drew in and out its long body.

P Q Fig. 13. repreſents one of the lice found on the beetle, called *Scarabæus Pediculoſus*, view'd by the fourth glaſs; P its *Anus*; Q its two claws, not unlike thoſe of a lobſter; *r r r r* the extremities of its feet, which have a remarkable contrivance for ſticking faſt on the ſmooth ſurface of the beetle; not in the manner of claws, as ſeveral other inſects, but divided into capilaments, as repreſented in the figure.

S Fig. 14. the ſame animal as it appear'd to the naked eye.

A Water-ſpout *at* Hatfield *in* Yorkſhire; *by Mr.* Abraham de la Pryme. Phil. Tranſ. N° 281. p. 1248.

ON the 15th of *Auguſt* 1687, about two o'clock in the afternoon, there appear'd a water-ſpout in the air at *Hatfield* in *Yorkſhire*; it was about a mile off, coming directly towards the place where Mr. *de la Pryme* was; the ſeaſon was very dry, the weather extremely hot, the air very cloudy, the wind a-loft and pretty ſtrong; and what was remarkable was, that it blew out of ſeveral quarters at the ſame time, and fill'd the air thereabout with very thick black clouds, in different layers; this blowing

of the wind ſoon caus'd a great vortex, gyration and whirling among the clouds, the center of which, every now and then dropt down, in the ſhape of a thick long black tube, commonly call'd a ſpout; in which Mr. *de la Pryme* could plainly ſee a motion like that of a ſcrew, continually drawing and ſcrewing upwards, as it were whatever it touched; in its progreſs it moved ſlowly over a hedge-row and grove of young trees, which it caus'd to bend, like haſel-wands, with a circular motion; then advancing forwards to a large barn, it twitch'd off in a minute all the thatch, and filled the whole air therewith; and coming to a very large oak, it made it bend like the aforeſaid trees, and broke off one of the largeſt and ſtrongeſt branches, and twiſting it about, flung it to a very conſiderable diſtance off; then coming within 300 yards of him, Mr. *de la Pryme* beheld this extraordinary phænomenon, and found that it proceeded from a gyration of the clouds, by the meeting of contrary winds in a point or center; and where the greateſt condenſation and gravitation was, falling down into a large pipe or tube, ſomething like the *Cochlea Archimedis*; and in its whirling motion, it either ſucks up water, or deſtroys ſhips, *&c.* having gone about a quarter of a mile farther, it was diſſolved by the prevalency of the wind, which was eaſterly.

The Miſchief occaſioned by ſwallowing Fruit-ſtones, *&c. by Mr.* Vaughan. Phil. Tranſ. N° 281. p. 1244.

A Gentleman had eat above two pounds of common prunes, and ſome time after, about a pound more; a fortnight before he died he had ſome ſymptoms of the ſtone; he had a violent pain in the neck of the *Veſica*, and about the *Urethra*, with obſtructions in his urine, *&c.* Mr. *Vaughan* ordered him a terebinthinate glyſter, which gave him eaſe; his pains afterwards increaſing, a phyſician was ſent for, who preſcribed glyſters, with diuretics and narcotics, to no purpoſe; after his death he was diſſected in preſence of Dr. *Weſt*, and others; when it was found that the prune-ſtones had made a perforation thro' the *Inteſtinum Rectum* into the *Pelvis*; upon tying a part of the gut, and cutting out a piece, and emptying it, there was taken out 128 prune ſtones, beſides what were left behind *in Stercore*, in the other part of the *Inteſtinum Rectum*: There was alſo a large *Polypus* taken out of the left ventricle of the heart.

Mr. *Vaughan* attended a young man (14 years of age, of a ſanguine complexion) for about 30 hours in an *Iliac* paſſion, which was very violent for the time; about 3 or 4 hours before he

he died, Mr. *Vaughan* administred a terebinthinate glyster, which gave, during its stay, immediate ease; he continued so for about an hour, when his disease returned again as severe as ever; some time before he died he voided some of his glyster by vomit; after he was dead, Mr. *Vaughan* dissected his body, and he found the liver only something bigger than ordinary; the stomach was considerably distended, and the *Fæces* had made a breach thro' the *Jejunum*, some of which was evacuated; a considerable portion of the *Ilium* was very livid, but not in the least distended; the *Colon* very much resembled a contus'd wound about 3 or 4 days old; in the centre he found it fresher, and not so livid as the outside; about the origin of the *Rectum* there was another large rupture, at which more *Fæces* were voided.

Mr. *Vaughan* had also dissected an emaciated person that had died of a dropsy, out of whose body he tapped 10 gallons of water: He also dissected a child, which had an involution of the intestines, popularly call'd the twisting of the guts.

Some Observations on Coral, *large* Oisters, *&c. in* Ceylan; *by Mr.* Strachan. Phil. Trans. N° 282. p. 1248.

THERE is a great quantity of white coral upon the shore between *Gale* and *Mature*, and several other coasts in the *Indies*, which the *Dutch* burn to make lime for building of houses and their fortifications; there are large banks of this coral; it is porous, neither so firm or smooth as the upright, which grows in small branches; and when they arrive to the full growth, there grow others betwixt them, and then upon these others come up, till it is become as thick as a rock; these branches are not softer when they are young than when they are ripe; yet Mr. *Strachan* always observ'd a slime upon them, which he supposed to be the substance that petrifies.

About 3 leagues from *Batavia* Mr. *Strachan* had seen oisters a foot in diameter; one of the shells of which grew till it was a foot broad and a foot thick; after the fish was putrified, he always observed a slime upon these shells, which lay only 3 or 4 foot under water: Upon the coast betwixt *Gale* and *Gindere* lies *Os Sepiæ*; and in the river at *Catoene* there are found rubies; and if a person searches among the sand in the water, he shall find above a drop weight of them in an hours time; but they are very small, and 20 of them will scarcely weigh a grain: Upon the sea coast there lie on the sands a kind of small cockles, as big as *oculi cancrorum*, or crabs-eyes, which have no cavity; and when they are pounded, they have the same effect with the testa-

teſtaceous powders, and are uſed inſtead of crabs-eyes: Here are ſeveral trees, ſome of which are above 6 fathoms high; whoſe roots grow, as it were, above ground in the following manner; when the twig is about half a foot high, there grows out of the middle of the ſtem, a little knot inclining downwards, that makes an angle with the ſtem of 30 degrees or thereabouts, till it touches the ground; where it fixes, emitting ſmall ſprigs, which before it touch'd the ground had neither branches nor leaves, but was all over green like a ſhoot; whilſt this ſhoot grows, and the ſtem becomes higher, it ſtill ſends forth other ſprigs, which always proceed from the middle of the trunk of the tree; thus it continues ſhooting forth, till the tree arrives at its full growth; and the higher the tree grows, the knots and ſhoots are the thicker, and the longer; ſo that one of the ſhoots which grows laſt, will be a foot thick in diameter, and 3 fathoms long: The flower call'd *Happumal* is found upon a tree that grows in the ſame manner, only two fathoms high; if planted round an orchard they make an excellent hedge; for the leaves are thorny and prickly; when the flower decays it bears a fruit like a pine-apple, but it is of no uſe: Some naturaliſts affirm that all plants have a heart, or ſomething analogous thereto; it would be worth enquiring in what part the heart of theſe kinds of trees lies, as alſo that of the *Palmito* and *Cocoa*-tree.

It is hard to tell which of theſe two divinities; *viz.* the *Budun* and *Sakradewendra*, have the greater veneration paid them; *Sakradewendra* commands and governs all the reſt of the Gods; and formerly he heard, they ſay, the prayers offer'd up to him from diſtreſſed people here upon earth, and granted their requeſts; but now the golden chair whereon he us'd to ſit is gone; and the prayers now offered up to him have no efficacy, becauſe the foot of that chair was made of a ſort of wax, which would turn ſoft by the prayers and tears of the ſuppliants, and ſo ſink downwards; by which means the *Sakradewendra* would look down and hearken to the prayer of the ſuppliant and grant his requeſt; this chair, which was of fine gold, was diſtributed amongſt the poor, which is the reaſon he does not now perceive, nor know when any one makes ſupplication to him; therefore, there are but few people that reap any benefit from the prayers and tears they offer to him; he can ſee a great way when he turns his eyes towards any place; for his forehead, the natives ſay, reſembles a peacock's tail, full of eyes; and ſo ſometimes it happens that he looks down and takes notice of men; but this is but ſeldom; therefore there is a neceſſity, ſay they, for one to

pacify theſe wicked ſpirits which trouble us here upon earth: Mr. *Strachan* could not learn how long this *Sakradewendra* had been a deity, nor how long he would reign; for none trouble their heads with him any more.

The *Budun*, of whom their *Banapots* (or bibles if they may be ſo call'd) make great mention, has been tranſmigrated into all the ſpecies of animals in the world; firſt into an inſect, and after his death his ſoul was regenerated into a mouſe, afterwards into an ox, then a monkey, and ſo forth, till he became a man; and by his good life and merits was ſtill promoted to a better ſtate, till at length he became ſupreme of all the Gods: There have been three *Buduns*; every one of whoſe reigns has been computed in this manner; there is a great hill about half a mile, of perpendicular height, and about ſix miles in circumference, from which a bird once in 1000 years takes one grain of ſand to a certain place, and every thouſandth year it continues ſo to do, till it has removed all the hill.

Concerning the Ancient Greek *and* Roman Lyre; *and an Explanation of an obſcure Paſſage in one of* Horace's Odes; *by Dr.* Molyneux. Phil. Tranſ. N° 282. p. 1267.

IN the third ode of the fourth book of *Horace*, which begins; *Quem tu Melpomene*, &c. (eſteem'd by the moſt learned critics both of the paſt and preſent age, one of the moſt correct maſter-pieces in its kind antiquity has left us) there is one of the moſt beautiful paſſages and ſurpriſing fancies of the ode, and which ſeems to have been overlook'd by all the critics and commentators;

O teſtudinis aureæ
Dulcem quæ ſtrepitum, Pieri, temperas?
O mutis quoque piſcibus
Donatura Cygni, ſi libeat, ſonum?

When Dr. *Molyneux* firſt reflected on theſe lines, and obſerv'd *Horace*'s great heat and vehemency in his repeated exclamations on the power of his muſe; as that ſhe could give, when ſhe pleas'd, even to mute fiſhes, the melodious voice of the ſwan; he look'd upon the fancy as entirely forced, and founded on nothing that was real or true in nature; and conſequently, it could paſs for no more than a wild rant, or extravagant whim of the poet's; yet, not being able to reconcile this with *Horace*'s character, as a great maſter and judge in the art of poetry, and par-

particularly remarkable for his propriety of thought and delicacy of expreſſion; upon ſecond conſideration he was convinced that this was the meaning of the paſſage, *viz.* that after he had, in the foregoing verſes, acknowledged how much he was indebted to the bounty of his muſe, he here makes a ſudden exclamation to extol her great art and myſtery, who by mixing various notes, could compoſe ſuch ſweet harmony upon the gilded lyre or *Teſtudo*, and by her ſurpriſing power could when ſhe pleas'd, give even to mute fiſhes, or the hollow ſhells of the *Teſtudines aquaticæ*, or water-tortoiſes (a ſort of fiſh, of whoſe ſhells the Dr. ſuppoſes they made their lyres in ancient times) the ſweet melody of the ſwan; as for the compariſon he makes to the voice of a dying ſwan, tho' that be a fiction, yet a vulgar error univerſally embraced, was ever ſufficient authority for either a poet or an orator to draw a compariſon, or ſimile from it.

The Dr. upon ſearching among ancient authors, whether or not, the *Teſtudo* or lyre of the ancients was made of the back, or hollow ſhell of the tortoiſe (as the name ſeem'd fully to import he found that it was a current piece of hiſtory generally receiv'd among the ancients, that *Mercury* was the firſt inventor of the lyre (whence *Horace* in his tenth ode of the firſt book ſtiles him *curvæ Lyræ Parentem*) and that he made it of the ſhell of a dead tortoiſe, he accidentally found on the banks of the *Nile*; and out of ſeveral teſtimonies, Dr. *Molyneux* ſelects the two following; the firſt is from *Nicander*, an old phyſician and a *Greek* poet, who writ above 100 years before *Horace*; in his poem call'd *Alexipharmaca* ſpeaking of the antidotes proper againſt the poiſon of the ſalamander, he recommends both the ſea and the mountain-tortoiſe in theſe words,

Αμμιγδην ἁλιοιο καθεψηθεντα χελωνης
Γυιοις ἡ ταχινησι διαπλωει πλεϱυγεσσιν
Ἀλλοτε δ᾽ουϱεσιης κυτισινομε ἣν τ᾽ ἀκακητα
Αυδησασαν ἐθηκεν ἀναυδητον πεϱ ἐουσαν
Ἑϱμειης, ζαϱκυς γαϱ ἀπονοσφισε γελειον
Ἀιολον, ἀγκωνας δε δυω παϱετεινατο πεζαις.

Tranſlated by *Joannes Gorræus* into *Latin* thus:

Cum curvâ auxilio veniunt teſtudine —
Quæ pelagi fluctûs velocibus innatat alis,
Aut montano etiam cytiſo quæ veſcitur & quam
Reddidit e mutâ modulanti voce canoram
Mercurius, picto inſontis qui cortice carnem
Exemit, geminumque Ancona intendit in oris.

Grevinus in his treatiſe *de Venenis*, *Cap. de Salamandra*, p. 119, gives us a comment on theſe verſes, and relates at large the hiſtory of the firſt lyre; and it is obſervable that this verſe

Αυδήεσσαν, &c.
Reddidit é mutâ modulanti voce canoram —

is ſo appoſite to the preſent purpoſe, and comes up ſo cloſe to *Horace*'s thought

O mutis quoque piſcibus, &c.

that it does not only explain the true meaning of it, but makes the Dr. inclinable to believe the *Roman* might have in his view this very paſſage of the *Greek* poet, when he writ theſe lines; and *Horace* uſes the ſame alluſion, tho' not ſo fully and expreſsly, in his eleventh ode of the third book, where he invokes his lyre.

Tuque Teſtudo reſonare ſeptem
Callida nervis
Neque, loquax olim, neque grata —

The other inſtance is from one of *Lucian*'s dialogues, who writ above 100 years after *Horace*; whence it is plain, that the mechaniſm of the ancient lyre, and the opinion concerning its firſt invention prevailed ſince, as well as before *Horace*'s days; *Lucian* in this dialogue introduces *Apollo* and *Vulcan* talking (after his jocoſe manner) of *Mercury* to this purpoſe.

Απ. χελωνην τι νεκραν ἑυρων, ὀργανον απ'αυλης συνεπηξατο, πηχεις γαρ εναρμοσας, ϗ ζυγωσας, ἑπειτα καλαμους εμπηξας, ϗ μαγαδιον ὑποθεις, κλα ἐντειναμενος ἑπτα χορδας, μέλωδεῖ πάνυ γλαφυρον ὦ Ηφαιστε, και ἐναρμονιον.

Ap. *Teſtudinem mortuam alicubi offendens, inſtrumentum ex ea concinnavit, brachia enim adaptans jugum oppoſuit, deinde clavos infigens & Hemiſphærium repandum infra ſubjiciens, ſeptem chordas extendebat, atque modulabatur quiddam valde ſonorum*, O Vulcane, *& ad Muſicæ melodiam compoſitum.*

Plate VI. Fig. 15. repreſents the ancient *Lyra* or *Teſtudo*, taken from Father *Merſennus lib.* 1. *de Inſtrumentis* p. 7. which he tells us he copied from the ſculpture of an antique gem, that belonged

belonged to one *Jacobus Gaffarellus*; A A ſhew the πηχεις of *Lucian*, the Αγκωνες, or *Brachia* of *Nicander*, made of the horns of ſome beaſt; B the Ζυγος, or *Jugum*, in which were faſtened the Καλαμοι, *clavi*, or pegs that raiſed or depreſſed c c the χορδαι or ſtrings, which were fixt at their other extremity to D the μαγαδιον, *Hemiſphærium*, or belly: This was really deſigned to expreſs the *Teſtudo Aquatica*, or rather *Fluviatilis* (as *Cicero* calls it in his *Natura Deorum*) taken from *Johnſtonus de animalibus*, as delineated in his 80th table *de Quadruped.* Fig. 16. making allowance for their different poſitions; the one being repreſented full and flat, whilſt only the half of the other appears, becauſe it is ſhewn ſide-ways; the belly of *Merſennus*'s ancient lyre, marked D, agrees exactly in figure and ſhape with the back, or ſhell of *Johnſtonus*'s *Teſtudo aquatica* mark'd E; they are both curiouſly teſſelated and checquer'd into areas, or ſcales FFF FFF, ſomewhat like a ſquare figure; and again each of theſe ſcales in both, is ſo neatly wrought about the edges with a line running parallel to the margins *g g g g g g*; and the ſhell of the lyre, as well as that of the tortoiſe, terminates in a narrow limb or verge, cut into ſmaller ſcales *h h h h h h* incompaſſing the whole; ſo that both theſe figures tho' drawn by different artiſts, perhaps, at 2000 years diſtance, do manifeſtly bear the lineaments of the ſame natural original: *Pauſanias* alſo in his deſcription of *Greece* (as quoted by *Geſner*) mentions a mountain in *Arcadia*, call'd *Parthenius mons, qui Teſtudines exhibet ad compingendas Lyras aptiſſimas*; and in another place, *Arcadum quercetæ ingenti magnitudine Teſtudines exhibent, ex quibus Lyras conficeres æquales illis quæ ex Indica Teſtudine componuntur.*

From whence it is plain that the ancients made their lyres of the ſhells of tortoiſes; perhaps uſing promiſcuouſly the land or river-tortoiſe, which occaſions *Nicander* and *Pauſanias* to mention the mountain-tortoiſe, whereas *Horace* ſpeaks of the river-tortoiſe, of which probably his lyre was made; and indeed, if we conſider the true riſe, or way of inventing of all ſorts of tools, weapons, machines and inſtruments that now prevail in the world, eſpecially thoſe of muſic, we ſhall find they conſtantly deriv'd their origin, and borrowed their firſt materials from ſomething that was natural, rude, plain, ſimple and eaſy to be come at; and thus the flute, flagelet, hautboy, and organs themſelves are only refin'd improvements of the *tenues Avenæ* or oaten pipes of the field, or the *Calami impares juncti* of the ancients, *i. e.* reeds of unequal lengths rudely put together; and thus we ſee

that

that the trumpets of old, were at firſt made only of rude horns of beaſts; and ſometimes of the common *Buccina-whelks*, or large ſea-ſhells; hence *Virgil*,

Rauco ſtrepuerunt cornua cantu.

and *Perſeus*

Buccina jam priſcos cogebat ad arma Quirites.

And afterwards when the *Romans* had enlarged their empire, were become more polite, and all their mechanical arts had received mighty improvements; tho' they had then learnt to make theſe inſtruments of different and more commodious ſhapes, and of quite other ſorts of materials, yet, ſtill they retain'd their old names; and this was alſo the caſe of the *Teſtudo*; for it is very manifeſt, that in ſucceeding ages, as the ſkill of the mechanic artiſt, that wrought and contriv'd the lyre, as well as that of the muſician that us'd the inſtrument, arriv'd at a greater perfection; the model of the old *Teſtudo* was much alter'd, the number of the ſtrings increaſed, and the ſhape ſo mightily diverſified, that at length, they wholly laid aſide the tortoiſe-ſhell; and the ſonorous part or belly of the lyre was made of ſuch different ſhapes that they bore not the leaſt reſemblance to its firſt model; this appears from thoſe other ſchemes *Merſennus* gives in the ſame table of the ſeveral ſorts of the ancient lyres (but theſe the Dr. takes to be more modern than that which is here expreſs'd) and from thoſe deſcribed by *Leonardo Agoſtini*, in the ſecond part of his collection of the *Gemme antiche*, which ſhews us, that as the fancy of the workman, the mode of the times, real convenience or imaginary beauty in the inſtrument determined it, they were faſhion'd into various ſhapes, and frequently like the lamps of old, into fantaſtical odd figures.

A Plumb-ſtone *in the Guts for* 30 *Years, &c. by Mr.* Yonge. Phil. Tranſ. N° 282. p. 1279.

SARAH Swayn, of a thin habit and middle ſtature, when but ſix years old, was firſt afflicted with a violent pain, together with a large hard ſwelling on the left ſide of her belly, which laſted 12 hours and then went off without the uſe of any remedy, or ſenſible evacuation; and at the end of three months it return'd, continued and went off as before; it obſerv'd that period for ſeveral years, and then it changed its interriſſion from three months to three weeks and continued ſo, till ſhe was 35 years old; in which time ſhe married and bore one child, the

pain

pain of which ſhe averr'd to be much leſs than what theſe paroxyſms gave her; during her pregnancy, neither her pains, nor her intermiſſions had any alteration; and in her whole life ſhe found no diet diſturbed her, but milk and ſalt-meats; about nine months before ſhe was cur'd, the pain increas'd, and the tumor became as big as a man's two fiſts; ſhe had endeavour'd to get eaſe by ſeveral remedies, but all in vain, till her agony and watchings had weaken'd her ſo, that ſhe could not riſe out of her bed: In this condition ſhe was adviſ'd by a woman to take a doſe of powder'd jalap, it operated violently, and ſuddenly drove the pain from her ſide down to the *Anus*, where it reſembled a *Teneſmus*, *viz.* a conſtant and violent inclination to ſtool, without being able to force any thing off; and after ſhe had been thus afflicted for four days, there was alſo a ſuppreſſion of urine, and two days after that, Mr. *Yonge* was call'd; he perceiv'd by the account given him, that ſomething obſtructed the paſſage of her *Fæces*, and he ſoon found it ſo by a probe; he then anointed the paſſage with *Populneum*, and taking hold of the ſubſtance with a pair of large forceps he extracted it; abundance of wind and *Fæces* guſh'd out, and continued to flow till her guts were emptied of all the matter, which had been ſo long retain'd therein; after which, he ordered her an anodyne glyſter and a compoſing draught; and for ſeveral years after, ſhe continued well; the ſubſtance extracted was round, ſomewhat oblong, having ſome ſuch impreſſions on it, as men's fingers make on wax, or plaiſter: it weigh'd then 10 drachms, but afterwards ſcarcely an ounce; it was five inches in circumference; altho' it felt, and otherwiſe appear'd like a ſtone, yet it ſwam on water; upon cutting it into two with a knife, to view the inſide, it appeared externally black and ſmooth, as if it had been varniſh'd, and no thicker; next to this was a cruſty ſubſtance like brick, half a crown thick; within that appear'd a ſubſtance reſembling paſteboard; and within that lay a prune, or wither'd plumb, with the ſtone and kernel cut aſunder by the knife: Thus all theſe ſurpriſing ſymptoms which ſo long afflicted this patient, were occaſion'd by ſwallowing this plumb-ſtone ſo many years before; but how thoſe different accretions were made to it; how it ceas'd to afflict her at ſo many and at ſuch different intervals; where it lay conceal'd between thoſe fits, and how the pain and tumor obſerved ſuch regular periods for ſo many years; at firſt every three months, and afterwards every three weeks? are queſtions Mr. *Yonge* leaves to others to reſolve.

Several

Several authors tell us of various ſtones ejected by ſtool, and ſeveral of them have been found to come from the gall-bladder of perſons in the jaundice: Mr. *Yonge* had ſeen two ſuch ſtones, bigger than any he ever read of; one as big as a pullet's egg, which proceeded from a lady in the operation of a ſtrong cholagogue; taken for a jaundice, that had baffled ſeveral other remedies; the other as big as a large nutmeg, voided by the ſame means from an aged man, languiſhing under the ſame diſtemper; and both theſe patients, for ſeveral days after thoſe ſtones came away, evacuated large quantities of choler by ſtool, and ſo got clear of the diſorder.

That theſe two ſtones were generated in the *Folliculus fellis*, or *Ductus choledochus*, appears, if we conſider the conſequence, and that in colour, taſte, weight, and ſhape, they reſemble ſuch as are found in thoſe parts upon diſſection of bodies affected with the jaundice; Mr. *Yonge* once ſaw near a handful of them taken out of the gall-bladder of the *Portugueze* Ambaſſador, who died at *London* 1679; and we are told by *Baglivius*, that the famous *Malpighi* was full of them; they are uſually of a ſub-citron colour, reſembling bright myrrh, and ſeem to be an aggregate of ſmall ſtones, which, perhaps, are generated ſingly in the *Veſicula*, and coaleſce in the *Ductus*: The conſequence of their coming off ſhews, that they cauſed the jaundice in thoſe two laſt mention'd perſons, by obſtructing the channels thro' which the bile paſſes from the common receptacle into the *Duodenum*; it may, perhaps, ſeem impoſſible to ſome, that ſubſtances of that bulk could paſs thro' a *Meatus* ſo ſmall as the common *Ductus* is; but Mr. *Yonge* diſſected a phyſician, who died of the jaundice, and found the *Ductus communis* wide enough to admit his largeſt finger.

The ſtones, which are generated in the guts, are of another ſort, and eaſily diſtinguiſhable from the foregoing; *Peckers* ſpeaking of ſome ſtones voided by ſtool, ſays —— *Calculos illos in Inteſtinis genitos eſſe, quia colore, pondere, & figurâ a choledochis lapillis diſtincti, arbitratus ſum*; i. e. *He ſuppoſes that theſe ſtones are generated in the inteſtines, becauſe they differ from thoſe in the gall-bladder, in colour, weight, and figure.* Thoſe generated in the gall cauſe the jaundice, thoſe in the guts, beget colic, ſplanchnical, hypocondriacal, and ſometimes nephritic pains, all which vaniſh, as ſoon as they are ejected.

Mr. *Yonge* had ſeen ſtones as big as a tennis-ball taken out of a bullock's guts; the authors of the *German* miſcellany write of one much bigger; *L. Riverius* gives an account of a man, who, by

by all his ſtools, continually voided ſtones like thoſe generated in the kidneys; *T. Bartholine* mentions ſeveral ſtones, one particularly remarkable, as big as a pigeon's egg, which was purged off from a woman by a gentle doſe of phyſick; *Ad. Med. Vol.* 1. *Obſ.* 110. *V.* 5. *Obſ.* 6. —— *in exteriore ſuperficie ſub-cinereum, & dum a me clavo ferreo in duas æquales partes diffringitur interius inſtar chryſtalli albicantem & rutilantem, ita ut qui olim ex Ennii ſtercore aurum, hic colligere potuiſſet gemmas*; i. e. *its outſide was ſomewhat of the colour of aſhes, but being divided into two equal parts, its inſide appeared white, and ſparkling like chryſtal.* There are ſeveral ſuch inſtances in the *Miſcell. Curioſ. Vol.* 7. *Obſ.* 9; but there is one much more ſo in *Ambr. Pary. Lib.* 25. *Cap.* 19, tho' neither of them had ſo ſtrange a cauſe or effect, as that mention'd by Mr. *Yonge.*

Beſides the moderns, *Galen, Crato, Sennertus, M. Donatus, Z. Luſitanus, Fernelius, G. Horſtius, Schenckius*, and ſeveral others have informed the world of ſtones generated in, and ejected from the inteſtines; but none with ſuch ſurpriſing circumſtances as this mention'd by Mr. *Yonge.*

A perſon in *Lancaſhire* had been ill for ſeveral years of the cholic, and received no relief from any medicine; being diſſected, after his death, there was taken out of one of his guts a large ball ſix inches round, weighing an ounce and a half, compoſed of a ſpungy ſubſtance, which ſwam in water, and viewed by a microſcope, it appear'd to conſiſt of very ſmall tranſparent hairs, or fibres, wrought together, after the manner of the *Tophus bovinus* extracted out of the maws of oxen; in the middle of it was a common prune, or plumb-ſtone, which having been ſwallowed, and ſticking ſomewhere in the guts, had gathered that ſubſtance about it, which reſembled the ſmall hairs on the ſkins of ſeveral animals, or the fibres of plants we eat; and upon cutting it, it was found to conſiſt of a hairy, or fibrous ſubſtance, in various layers, over a plumb-ſtone, which ſeemed to be of the ſame ſubſtance with that mention'd by Mr. *Yonge.*

Dr. *Cole* had ſome balls ſmaller than the two above-mentioned, which had plumb-ſtones in their centres; the perſon, on whoſe account the Dr. was conſulted, had had the cholic to a great degree, and had voided ſeveral of them; they were not ſo ſpherical, but of a compreſſed figure, ſmooth and glaz'd on the outſide, as ſome of the *Tophi bovini* are; and within, they ſeemed to be of the ſame ſubſtance with the former, in different layers upon a plumb-ſtone.

Dr. *Thompſon*, in his *Experimenta admiranda*, p. 67, gives a large account of a ball which had been voided by a patient after a great fit of illneſs, of the ſame bigneſs, and in appearance of the ſame ſubſtance with the former; that author tells us, it had ſeveral plumb and cherry-ſtones in it: Theſe balls ſeem to be formed ſomething after the manner of bezoars, which generally have ſome ſeed for their centre, or *Nucleus*, on which are formed coats of another ſubſtance.

Theſe inſtances are ſufficient to ſhew the folly of the common opinion; *viz.* that the ſtones of fruit are wholeſome; for, tho' the guts are by nature ſo defended by the *Mucus* of the inteſtines, that people ſuffer very ſeldom thereby; yet, if we conſider the various circumvolutions of the guts, their valves, and cells; as alſo, the hair of the ſkins of animals we feed on; the wool, or down, on herbs and fruits; the fibres, veſſels, and nerves of plants which are not altered by the ſtomach, the like caſe may very eaſily happen: A certain patient had a ſurpriſing, obſtinate, and long diſorder that proceeded from a great quantity of ſtrawberry-ſeeds, which had lodged themſelves in the guts, and after their diſcharge, he was relieved; and ſeveral have loſt their lives by ſwallowing a quantity of cherry-ſtones.

The Veſtigia *of a* Roman Town *at* Adel *in* Yorkſhire; *by Mr.* Thoresby. Phil. Tranſ. N° 282. p. 1285.

THE veſtiges of a *Roman* town are to be ſeen upon the moor near *Adel* mill, four miles from *Leeds*, and they were accidentally diſcovered by a farmer, who ploughing part of his farm, was retarded by a great quantity of ſtones, which lay immediately below the ſurface of the ground, and which he was oblig'd to dig up before he could proceed; at a very little diſtance is a *Roman* camp pretty entire, it is above four chains broad, and five long, ſurrounded with a ſingle *Vallum*, which from the top of the *Agger* to the bottom of the trench is ſtill 22 foot deep, where Mr. *Thoresby* meaſur'd it; the town ſeems to have been of conſiderable note, by the inſcriptions, and fragments of ſtatues, pillars, *&c.* dug up there, all which (as Dr. *Liſter* has truly obſerv'd of moſt of the *Roman* monuments in theſe parts) are made of the common ſort of coarſe rag, or milſtone grit, of which are alſo the remains of a large aquæduct, being ſtones of a great length, and about ¾ of a yard thick, wherein the paſſage for the water is about ſix inches broad, and as many deep, almoſt double to thoſe of clay found in the *Roman* burying-place at *York*; a ſtatue was dug

dug up here, to the full proportion of a *Roman* knight or officer, with an inſcription thereon; there were alſo diſcover'd two inſcriptions; the one was only a fragment, which yet had enough to ſhew that it was ſepulchral, by the H. S. E. for *hic ſitus eſt*, below PIENTISS; the other was almoſt entire and plainly appear'd to have been a funeral monument, it begins as uſual, with *Diis manibus ſacrum Cadiedinæ Fortuna Pia*; and ends *Vixit Annos* X; it is a foot thick, two foot broad and three foot high; the letters are very large, full three inches long, ſome of them interwoven, as AND AD and ED (as Mr. *Thoreſby* ſuppoſes the EO to be) in *Candidianæ*, the form of the letters, and particularly the A may, perhaps diſcover the age this *Roman* ſtation flouriſh'd in; *viz.* in *Severus*'s reign *An. Dom.* 194 or before, if the obſervation of Mr. *Cambden* in his *Britannia* p. 808, holds good, from which none of the modern critics diſſent; 'this obſervation, ſays he 'I have made, that from the age of *Severus* to that of *Gor-* 'dian, and after the letter A in the inſcriptions found in this 'iſland, wants the croſs ſtroke, and is engraved thus Λ'.

This *Roman* ſtation was deſtroy'd, probably, by fire (as may be conjectur'd from the flag and aduſt colour found in ſome places) in ſome of the inſurrections of the native *Brigantes*, who were impatient of reſtraint; amongſt the ruins were found two or three mill-ſtones for grinding corn, which, by the ſmallneſs of the ſize, being 20 inches in diameter, ſhew that the *Romans* of thoſe, as well as the *Egyptians* and *Jews* of former ages, made uſe of their ſlaves, or captives for that drudgery, who were plac'd *poſt molas*, Exod. XI. 5. *non præcedunt, ſed ſequunter, brachiis & toto corpore trudentes*; and what the old MSS. bibles have in reſpect to *Sampſon*, Judg. XVI. 21. *clauſum in carcere molere fecerunt*; our *Saxon* predeceſſors render expreſſly *hanbc pypne*, Mr. *Thwait's Hept. Anglo-Sax*; beſides this, which was entire, Mr. *Thoreſby* had a fragment of another mill-ſtone, whereon the rows were ſtill remaining, which being heavier, and almoſt as thick at the circumference, as the other is at the centre (for they are convex on one ſide) Mr. *Thoreſby* ſuppoſes might have been the *Runner:* The learned *Gataker*, in his notes on *Iſai* XLVII. 2. obſerves, that the original word is of the *Dual* form, and that the law, prohibiting to take the mill-ſtone to pledge, does particularly mention *Receb*, or the *Rider*; becauſe, that lying looſe might be the more readily taken off, and carried away upon that occaſion; and in his annotations upon *Lament.* v. 13.

they took the young men to grind; he ſays, that the *Talmudiſts* have a ſtory, that the *Chaldeans* oblig'd the young men to carry mill-ſtones with them to *Babylon*, where there was a great ſcarcity of them; whence probably, their paraphraſe renders that text, *have borne the mills, or mill-ſtones*, which might be true in a literal acceptation; they have alſo a proverbial ſpeech of a *man with a mill-ſtone about his neck* (alluded to in St. *Matth.* XIX. 6.) uſed to expreſs one that lies under an exceeding heavy, and almoſt inſupportable burden.

Mr. *Thoresby* found here the fragments of urns, and other *Roman* veſſels; one of which was 23 inches, or 2 foot in circumference; moſt of them were of the common red clay; and he alſo had one of the beſt coral-colour'd varniſh, and others of a bluiſh-grey, as alſo a braſs ring found in the ſame place: The *Roman* ridge, on which this town ſtood, comes from the large military road upon *Bramham-moor*, of which *Leland*, in his MS. *Itenerary* affirms; 'I never ſaw, ſays he, in any 'part of *England* ſo manifeſt a token, as here, of the large 'creſt of the road of *Watling-ſtreet*, made by hands'; from thence this *Via vicinnalis* paſſes by *Thorner* and *Shadwel*, *Street-lane* and *Hawcaſter-ridge* upon *Blackmoor* (near which is the *Roman* pottery, mentioned *Phil. Tranſ.* N° 222.) to *Adel*; from thence thro' *Cookridge* over the moors towards *Ilkley*, a known *Roman* ſtation; this ſame ridge is very evident in ſome part of the ground of *Tho. Kirk* of *Cookridge*, Eſq; who ſhewed Mr. *Thoresby* the place where a *Roman* monument was dug up, which ſeem'd to have had a large inſcription, but ſo eraſed that nothing diſtinct could be made of it; perhaps, the ſaid *Cukeryg*, as it is called in the original letters patent of King *Edward* VI. to archbiſhop *Cranmer* (in the poſſeſſion of the gentleman above) was ſo denominated from this *Roman* ridge, which paſſes directly thro' it; but, what the name of this ſtation was, Mr. *Thoresby* cannot imagine: Dr. *Gale* gave him an account, from an anonymous geographer, of a ſtation in theſe parts called *Pampocatia*, which he thought ſhould be read *Campocatia*, and had ſent to *France* for various readings, concluding; 'Where to place this I 'know not, but I am hopeful you will be ſo happy as to find 'it, and ſo kind as to make the diſcovery', *&c.* Now conſidering, that in the ſaid author, printed at *Ravenna*, *An. Dom.* 1688, this *Pampo*, or *Campocatia*, is the very next ſtation to *Lagentium* or *Legeolium*, it ſeems not improbable that this camp, *&c.* was the very place; but as things, ſo many ages paſt,

paſt, admit of various conjectures, Mr. *Thoresby* offers another, which he was inclined to, from the ſimilitude of the names, the *Agel* or *Adelocum* of the ancients, and preſent *Adle*, or *Adel*, as it is in the *Monaſticon Anglican*. It is true, that it is ſometimes writ *Segelocim*; but, as Mr. *Burton* well obſerves, in his comment on *Antoninus*'s itinerary, it is to be reckoned amongſt thoſe words, to which the ancients ſometimes put an S or *Sibilus*, and ſometimes omitted it; if this be thought too northward for that ſtation, which is placed ſouth of *Danum*, it may be replied, that, not to inſiſt upon the tranſpoſition of ſome places, of which there are inſtances in the itinerary; Mr. *Thoresby* ſees no inconveniency in admitting, that the *Romans* might then, as we at this day, have ſeveral towns of the ſame name; thus, from an altar which Mr. *Thoresby* had inſcribed CONDATE, the ſaid Dr. *Gale* concludes, that *Couſley* near *Piersbridge*, where this altar was found, was as well called *Condate*, as *Congleton* in *Cheſhire*; and it ſeems highly probable to Mr. *Thoresby*, that the legions, being detach'd againſt the enemy to diſtant places, might endeavour to leave ſuch memorials of their removes: Thus, the *Legio viceſima valens Victrix*, uſually quarter'd at *Deva*, or *Weſt-Cheſter*, was detach'd to *Weſtmorland*, as appears by an inſcription; and Mr. *Thoresby* does not queſtion, but that the *Lingones*, who were ſeated at *Ilkley*, were alſo at *Lingivel* near *Thorp on the Hill*, where the *Roman* coining-moulds in *Phil. Tranſ.* N° 234, were found; and that the intrenchments there were ſo denominated from them, the *Roman Vallum* being pronounced *Wallum*, of which ſee *Cauſabon*, *Somner*, &c. At this *Agelocum*, or *Adelocum*, as *Cambden* himſelf once read it, is a church of the moſt antique form Mr. *Thoresby* ever ſaw, and, being built of ſmall ſquare ſtones like the *Roman* wall, and multangular tower in *York*, he took it to be the remains of ſome *Roman* temple, till he found therein ſome Chriſtian hiſtories; particularly, the deſcent of the Holy Ghoſt in the form of a dove, done in *baſſo relievo*, but in ſo very rude a manner, as ſufficiently evinces their great antiquity; the inhabitants have an old tradition, that *Adel* church once ſtood upon *Blackhill*, the place where theſe *Roman* monuments were diſcovered, occaſioned perhaps by the removal of the ſtones from ſome publick edifice at the deſtruction of the old *Roman* town.

Of

Of Secretions *in an* Animal Body; *by Dr.* Morland. Phil. Tranſ. N° 283. p. 1293.

THE whole buſineſs of animal ſecretion ſeems to Dr. *Morland* to be reducible to this double enquiry: 1. How a thin fluid, ſuch as is the urine, may be ſeparated from the maſs of blood, and the remaining parts of the blood return again to the heart? 2. How a thick fluid, ſuch as is the bile, or *Semen*, may be ſeparated from the maſs of blood, and the other fluids, both thinner and thicker than this particular fluid to be ſeparated, return again to the heart? To make the thing plainer, the Dr. gives a general idea of the ſtructure of the glands; and a gland, he takes to be compoſed; 1. Of the ramifications of the blood-veſſels incloſed in a common membrane, which ſends off ſeveral fibres, by which theſe minute veſſels are tied together; and that the veins are a continuation of the arteries; of this Dr. *Areskin* has fully convinced us, by an injection of wax in a human ſubject, ſo dexterouſly perform'd, that the wax being injected by the arteries, filled the veins at the ſame time; and afterwards, by a nice diſſection of the part, where the continuation of the ſmall ramifications of the arteries and veins appeared to the naked eye. 2. Dr. *Morland* ſuppoſes, that when the branches of the arteries begin to grow very ſmall, they ſend off ſeveral ducts, whoſe orifices are of different dimenſions; and theſe ducts are of two ſorts; the 1ſt of theſe, which in the ſame artery, are always ſmaller than the 2d, paſs immediately from the artery, and open into the veins; the 2d, which paſſes off nearer to the extremity of the arteries, unite, and carry off a liquor from the maſs of blood, for particular ends in ſeveral parts of the body; it is to be obſerv'd, that in one caſe the 2d ſort are only to be found: The Dr. ſuppoſes that a thin fluid may be ſecern'd from a thick one, when the orifices of the ſecretory ducts are ſo ſmall, as to admit no other but that thin fluid; and that at the ſame time, the remaining parts of the blood which are thicker, continue their courſe in the veſſel; again, he ſuppoſes, that a thick fluid may be ſecern'd when the thinner parts are carried off ſome other way, ſo that the liquor to be ſecern'd, will be the thinneſt of the remaining maſs; upon theſe principles, the Dr. thinks it will be eaſy to explain the doctrine of ſecretions: And now, in the 1ſt place, let us examine how the thinner ſecretions are perform'd, as for inſtance, the urine; when the blood, by the contraction of the heart, is propell'd into the arteries,

arteries, they are dilated, and again contracting themſelves, they puſh it forwards into all the parts of the body; and amongſt the reſt, into the ramifications of the arteries, of which the glands of the kidneys are compoſed; by this means, the blood paſſes by the orifices of the ſecretory ducts; when theſe arteries contract themſelves, they preſs the blood, and force the thinner parts into the orifices of thoſe ducts (which will admit no thicker fluid) and carry it towards the *Pelvis*, and the remaining part of the blood into the veins, by them to be return'd back to the heart; and thus, a thin liquor may be ſeparated from the maſs of blood. In the 2d place, let us examine, how a thick liquor may be ſeparated from the maſs of blood, where thinner liquors are mix'd therewith; for inſtance, let us take the gall or *Semen*; when the blood is puſh'd into the celiac or meſenteric arteries, it is forced to paſs into the glands of the ſtomach, pancreas, ſpleen, and inteſtines, *&c.* where the *Liquor Gaſtricus*, *Succus Pancreaticus*, *Liquor Inteſtinalis* are ſeparated by the above-mention'd method; the blood, being thus diveſted of various thin liquors, is puſh'd on into the veins correſponding to theſe arteries, which veins unite, and form a large trunk called the *Vena Porta*, which entering into the ſubſtance of the liver, by its ſmall ramifications, chiefly forms the glands, of which the liver is compoſed; here again, all the fluids contain'd in the *Vena Porta*, which are thinner than the bile, are ſeparated from this maſs of blood, by the firſt ſort of ſecretory ducts (which were ſaid to open into the veins) and there they are diſcharged and mixed with the blood, which is paſſing on towards the heart; at the ſame time the bile, with the reſt of the blood, which is thicker, continues its courſe in the artery; and now, all the thin liquors being ſeparated, the bile is the thinneſt part of this maſs of blood, and ſo it may be received by excretory ducts, which are capable to receive it, and no other.

The *Semen*, being a very thick liquor, is ſeparated much after the ſame manner, *viz.* the blood, being puſh'd into the ſpermatic arteries, paſſes into the ſubſtance of the *Teſtes*; where all the liquors that are thinner than that, out of which the *Semen* is to be taken, are ſeparated by the 1ſt ſort of ſecretory ducts, and carried back to the maſs of blood; then, this *Liquor Seminalis*, being the thinneſt part of the remaining maſs, is ſeparated by ſecretory ducts, capable to receive it, and no other; after that, the *Liquor Seminalis* is ſeparated from the maſs of blood by the aforeſaid method, it is puſh'd for-

forwards into the ſecretory ducts, where there are other ducts, which take their origin all along from them, which ducts are capable of receiving the thinneſt parts of the *Liquor Seminalis*, and convey them to the maſs of blood; and thus, the *Semen* is left behind to paſs into the *Vas deferens*; and it is worth obſerving, that as the *Semen* grows thicker and thicker, by continual ſeparation, the canal in which it is to run, grows larger and larger, as appears by the ſtructure of the *Teſtes Epididymis & Vas deferens*; hence we may give a true account, why the canals of which the *Teſtes* are compoſed, are ſo long, *viz.* that there might be time enough to ſeparate all the thin fluids: By this method we ſee, how the thickeſt and thinneſt fluids may be ſeparated from the maſs of blood; and how intermediate liquors may be ſeparated after the ſame manner, by canals of intermediate dimenſions; thus, in a word, the whole doctrine of ſecretions may be reduc'd to this, *viz.* that in order to ſeparate a liquor of any determin'd thickneſs, all the fluids, which are thinner, muſt be carried off by ſmall canals, and the liquor to be ſeparated, being the thinneſt of the remaining maſs is ſecern'd, becauſe the ducts are capable to receive it, and no other.

Corrollaries. 1. Hence, the uſe of the ſpleen is evident. 2. Hence appears the origin and uſe of the lymphatics. 3. Hence the texture and uſe of ſeveral minute parts of the body may be diſcovered, which hitherto have been unknown.

Worms *in Human Bodies*; *by Dr.* Bononio. Phil. Tranſ. N° 283. p. 1296.

HAVING frequently obſerv'd that poor women, when their children are troubled with the itch, do with the point of a pin pull out of the ſcabby ſkin little bladders of water, and crack them like fleas upon their nails; and that the ſcabby ſlaves, in the bagnio at *Leghorn*, do often practice this mutual kindneſs upon each other; the Dr. propoſed to examine what theſe bladders might really be; upon aſking an itchy perſon, where he felt the greateſt, and moſt acute itching, he pointed to a great many little puſtules not yet ſcabbed over, of which picking out one with a very fine needle, and ſqueeſing a thin matter from it, the Dr. took out a very ſmall white globule, ſcarcely diſcernible; upon obſerving this with a microſcope, he found it to be a very minute animal, in ſhape reſembling a tortoiſe, of a whitiſh colour, a little dark upon the back, with ſome thin and long hairs, of a nimble motion, with

with ſix feet, a ſharp head, and two little horns at the extremity of the trunk, as repreſented in Plate VI. Fig. 17. and 18: The Dr. repeated the enquiry in ſeveral itchy perſons of different ages, complexions, and ſexes, and at different ſeaſons of the year; and in all he found the ſame animals, and that in moſt of the watery puſtules; for, now and then, in ſome few he could not ſee any; and tho' by reaſon of their minuteneſs and colour, being the ſame with that of the ſkin, it is hard to diſcern theſe animals upon the ſurface of the body, yet he has ſometimes ſeen them upon the joints of the fingers, in the little furrows of the *Cuticula*; where they firſt begin to enter with their ſharp head, and by thus gnawing and working in with their bodies, they cauſe a very troubleſome itching, till they are got quite under the *Cuticula*; and then, it is eaſy to ſee how they remove from place to place by their biting and eating; a ſingle one ſometimes makes ſeveral puſtules, of which the Dr. had often found two or three together, and for the moſt part pretty near each other.

The Dr. very carefully examined, whether or not theſe *Animalcula* laid any eggs; and after ſeveral enquiries, at length he ſaw drop from the hinder part of one of them a very ſmall, and ſcarcely viſible, white egg, almoſt tranſparent and oblong, reſembling the ſeed of a pine-apple, as repreſented Fig. 19. and 20; he often found theſe eggs afterwards, from which, he doubts not, theſe *Animalcula* are generated, as all others are, that is, from a male and female; tho' he could not by any difference of figure diſtinguiſh their ſex.

From this diſcovery it may be no difficult matter to give a more rational account of the itch, than hitherto hath been done; it being very probable, that this contagious diſtemper owes its origin, neither to the melancholy humour of *Galen*, the corroſive acid of *Sylvius*, the particular fermentation of *Van Helmont*, nor to the irritating ſalts in the *Serum*, or *Lympha* of the moderns, but rather to the continual bitings of theſe *Animalcula* in the ſkin; by means of which ſome portion of the *Serum*, ouzing out thro' the ſmall apertures of the *Cutis*, little watery bladders are produced, within which the inſects continuing to gnaw, the infected perſon is forced to ſcratch, and by ſcratching he increaſes the malady; and thus repeating the troubleſome work, he not only breaks the little puſtules, but likewiſe the ſkin, and ſome ſmall blood-veſſels, and ſo cauſes ſcabs, cruſty ſores, and ſuch like foul ſymptoms: From hence alſo we come to underſtand, how the itch comes to

be a diſtemper ſo very catching; ſince theſe animals, by ſimple contact, can eaſily paſs from one body to another, their motion being exceeding ſwift, and crawling as well upon the ſurface of the body, as under the *Cuticula*, they are very apt to ſtick to every thing that touches them; and a few of them being once lodged, they multiply a-pace by the eggs which they lay; nor is it any wonder, if this infection is propagated by means of ſheets, towels, handkerchiefs, gloves, *&c.* us'd by itchy perſons; it being eaſy enough for ſome of theſe creepers to be lodged in ſuch things as theſe; and indeed, the Dr. has obſerved that they will live out of the body two or three days; nor, in the laſt place, ſhall we be at a loſs to know the reaſon of the cure of this malady by lixivial waſhes, baths and ointments made up with ſalts, ſulphurs, vitriols, mercurys, precipitate or ſublimate, and ſuch ſort of corroſive and penetrating medicines, theſe being infallibly powerful to kill the vermin lodged in the cavities of the ſkin; which ſcratching will never do, partly by reaſon of their hardneſs, and partly becauſe they are ſo minute, as ſcarcely to be found out by the nails; neither do inward medicines perform any real ſervice in this caſe, it being always neceſſary, after a tedious uſe of theſe, to have recourſe to thoſe external ones already mention'd; and if in practice we often experience, that this diſtemper, when we think it is quite cur'd by unction, does yet in a ſhort time return again; this is no ways ſurpriſing, ſince tho' the ointment may have kill'd all the live *Animalcula*, yet probably, it may not have deſtroy'd all their eggs, laid as it were, in the neſts of the ſkin, from which they may afterwards breed again, and renew the diſtemper; and upon this account it is very adviſable, after the cure is once performed, ſtill to continue the anointing for a day or two more; which may be done the more readily, becauſe theſe liniments may be made agreeable enough, and of a good ſmell; as particularly, that compounded of the ointment of orange flowers or roſes, and a ſmall quantity of red precipitate.

A Piece of a Dog's Gut *cut out, and cur'd; by Mr.* Shipton. Phil. Tranſ. N° 283. p. 1299. *Tranſlated from the* Latin.

IT is an opinion handed down from remoteſt antiquity, that wounds in the thick guts are generally mortal, but in the thin ones, always ſo; *Hippocrates Aph.* 18. and *Aph.* 24. *Lib.* 6. paſſes an unfavourable judgment on them; as alſo *Celſus Lib.* 5. *Cap.* 26. and *Lib.* 7. *Cap.* 16; and *Fabritius ab Aquapendente*, the prince of modern ſurgeons, *Operat. Chirurg. Cap.* 53. giving

ing an account, why the method of ſewing the guts was omitted by *Galen* and *Paulus*, confirms this judgment from his own experience: It is true, *Paul Barbette* aſſerts that a wound in the thin guts has been ſometimes cur'd; of which he could, he ſays, give a remarkable inſtance, *Chirurg. Part.* 2. *Lib.* 2. *Cap.* 11. yet, it were to be wiſhed that he had given poſterity a more particular account of a caſe ſo uncommon and ſo contrary to the ſentiments both of the ancients and moderns, that we might form a more certain judgment about it; and it is ſurpriſing that none of his co-temporary phyſicians ever mention'd ſuch a remarkable cure: Tho' all agree that a wound in the human inteſtines is very dangerous, yet it is not ſo in dogs; as appears from the following experiment: Mr. *Shipton*, having tied a dog as uſual, made a pretty large wound in the *Abdomen*, then pulling out a part of the *Ilium*, he tied up the meſeraic veſſels, which convey blood thereto; and cutting the gut tranſverſely in two places with a pair of ſciſſars, he took away about two fingers length thereof; then with the ſkinners ſuture he ſewed up the wound in the gut, and with the interrupted ſuture that of the *Abdomen*, which he cover'd with a plaiſter, and untying the dog, he rolled bandages round the part; at firſt the dog ſeem'd to reel, as if he had been ſeis'd with a *Vertigo* or dizzineſs, and to be very weak; and the ſame night he vomited twice; in a few days after, the ſtitches ſlackening a little, they were braced up tighter, and afterwards taking off the plaiſter and bandages, in about three weeks time, the dog by licking the wound, made it cicatrize; the retraction of the gut, as ſoon as it was cut, was very obſervable here, elegantly reſembling a ſphincter; in ſome weeks after the dog was perfectly recovered, and lively, Mr. *Shipton* hang'd and open'd him; when he found that the part of the gut, where it was ſew'd, ſtrongly adher'd to the *Peritonæum* at *f* Plate VI. Fig. 21. in the left *Hypocondrium*, (at a good diſtance from the external wound, which had been made in the right *Hypogaſtrium*) and it was form'd into a large bag DDD; the *Omentum* G did alſo adhere thereto, and the inteſtines thereabouts coaleſced together in ſeveral places, as ** *ee*: In order to view the *Cicatrix* on its internal ſide *c*, the more exactly, he cut the gut lengthwiſe; and it appear'd that the lips of the wound were on one ſide DDD united and connected with the *Peritonæum f*, and on the other ſide divided, and ſtrongly adhering to the adjoining inteſtines; in ſuch a manner that their external coats, forming the internal *paries* on that ſide, ſerved to form the continuation of the inteſtinal duct, and to protrude the ali-

ments: *Brunnerus, in Præfat. ad Experim. nova circa Pancreas*, mentions his having wounded a dog an inch and a half in one of the thin guts, who afterwards recover'd, tho' with ſome difficulty: Mr. *Cowper* perform'd the like operation with more ſucceſs; for Phil. Tranſ. N° 208. he ſays, that dividing lengthwiſe one of the thin guts in a large dog; he had in a ſhort time cur'd him, without ſtitching the gut, only ſewing up the *Abdomen*, and without any dangerous ſymptoms; and that either with or without Dr. *Colbatch*'s ſtyptic powder, which was then much cried up; yet it does not appear, that in either of thoſe caſes the gut was cut quite thro', or any portion of it taken away: Dr. *Wallis* mentions an inſtance not unlike theſe, Phil. Tranſ. N° 219. of a horſe, who by leaping, had ſtaked himſelf into the ſtomach, and had continu'd ſo for ſome hours before the farrier came to dreſs him; who enlarg'd the wound, ſew'd up the ſtomach, and ſlightly ſtitched the lips of the wounded *Abdomen*, and put in tents; ſo that in a few week's after, the horſe recover'd.

Tho' theſe experiments have ſucceeded well in beaſts; yet Mr. *Shipton* does not doubt but that the cutting away one of the thin guts of a man, would be as certainly mortal, as if he was run thro' the heart; for the thin guts in men have not ſuch a ſtrong contexture of fleſhy fibres, as thoſe of dogs have; who being accuſtomed to harder food, ſeem to require a greater motion and heat in the inteſtinal tube, for elaborating the chyle and excluding the *Fæces*, which are commonly harder in them than in other animals: Tho' chirurgical operations are not performed on brutes, yet ſuch experiments may ſometimes be made on them, as may afterwards become ſerviceable to mankind; for obſerving that the guts of a dog, after cutting out a portion thereof, do again coaleſce and unite; the wounds in thoſe of a man, at leaſt in the thick inteſtines, may be ſew'd up with the greater proſpect of ſucceſs.

Plate VI. Fig. 22. A *a a* repreſents the ſuperior part of the *Ilium* towards the ſtomach; B *b b* its inferior part; C the *Cicatrix* or ſcar of the wounded gut on its internal ſide; D D D the lips of the divided gut; E its ſuperior orifice; F its inferior orifice; *e e e* the exterior parts of the adjacent guts, which ſupply the portion of the gut wanting in this place; *f* the portion of the *Peritonæum* that adhered to the gut; G the *Omentum* that was likewiſe connected to it; * * the veſtiges of the divided gut, where it adher'd to the other; H H the trunk of the *Aorta*; I the cæliac artery; *g* the right gaſtric; *h* the right gaſtro-epiploic artery; *i* the hepatic arteries; *k* the pyloric artery; *l* the *Gaſtrica*

ſtrica major; *mm* the ſplenic artery; K the ſuperior meſenteric artery; L the phrenic arteries; O the trunk of the *Vena Porta*; PP the ramifications of the arteries and veins in the meſentery.

Green-weeds *growing in Water, and* Animalcula *found about them; by M.* Leewenhoeck. Phil. Tranſ. N° 283. p. 1304.

THE green ſtuff or weeds, which are obſerved to drive upon the water, are ſuppos'd by the common people to ſpring out of the ground from under the water; but M. *Leewenhoeck*, as often as he obſerved the ſaid weeds, always found that they were produced from ſeeds of the ſame kind, like all other trees and plants; he likewiſe obſerved, that this green matter does not grow in deep waters, tho' they are narrow, and ſtill; but that wide and ſhallow waters eſpecially moats and ditches abound therewith; and that the wind does it no hurt; he alſo found that the green weeds in thoſe ditches, which have but little water, are very ſmall in compariſon of thoſe in larger waters, and near the ſides of the banks, where they are ſhallow, and where the water had but little motion: By means of a ſluice, the water of the river *Maes* (ſwelled by the ſummer-floods) is brought to *Delft* from *Delfs-haven*, a town about two hours diſtance from it, and with this water there comes in a little of this green ſtuff; M. *Leewenhoeck* having fiſh'd up about 30 of thoſe weeds, as deep as he could, that he might not break the roots, he put them into an earthen pot, together with a large quantity of their own water; and taking very nicely with a needle out of the pot ſeveral of theſe weeds one by one, he put them into a glaſs-tube of a finger's breadth which was fill'd with water, and likewiſe into a ſmaller tube; and cauſing the roots of the weeds to ſubſide leiſurely, he view'd them with his microſcope, and obſerved a great many different kinds of *Animalcula*; two ſorts of which had long tails, whereby they ſeem'd to be faſtened to the roots of the weeds; theſe *Animalcula* were ſhaped like a bell, and they moved the ſmall cavity of their bodies in ſuch a manner, that putting the little particles of the water into a commotion, M. *Leewenhoeck* could not ſee the inſtruments whereby they produced the ſaid motion; and tho' he had ſeen 20 of theſe *Animalcula* together, gently moving their long tails, and outſtretch'd bodies, yet they contracted both in an inſtant, and then ſoftly extended them again; and this kind of motion they continu'd for a great while.

Plate VI. Fig. 23. A B C repreſents one of the green weeds of a common ſize, as it lay upon the water, and appear'd to the naked eye.

Fig.

Fig. 23. DEFG ſhews the very ſame weed, as it appear'd in the glaſs-tube, fill'd with water, with its roots extended.

Fig. 24. HIKLMNOPQR repreſents a ſmall part of the roots, as it appear'd in the microſcope, thro' the whole length of which, were to be ſeen its veſſels with their diviſions; theſe roots M. *Leewenhoeck* ſuppoſes, were of no further uſe, and in a manner wither'd; they were alſo overgrown with a great many peculiar long particles, and moſtly with little figures like flowers, as repreſented between K and L; the *Animalcula* reſembling little bells are to be ſeen in IST and NVW; and he ſaw above 100 of theſe *Animalcula*, with their tails faſtened to the root, and living between HIKLM; but other roots had none of theſe; in ſeveral of theſe roots M. *Leewenhoeck* obſerved one, and ſometimes (but ſeldom) two ſheaths or caſes of ſeveral ſizes faſten'd in them; the largeſt is repreſented by RXZY; there appeared out of the ſame ſheath a little animal, the fore-part of whoſe body was roundiſh, as in XZY; and preſently there proceeded from that rotundity two little wheels, that had a ſwift gyration always one and the ſame way, as in *abc*; theſe ſmall wheels were ſet as thick with teeth, as the wheel of a watch; and when theſe *Animalcula* had for ſome time exerted their circular motion, they drew the wheels into their bodies, and their bodies wholly into their ſheath, and ſoon after they thruſt them out again with the aforeſaid motion; another while they continued ſhut up in their ſheaths; and tho' he had alſo obſerved the like wheels in other *Animalcula*, yet their bodies differ'd from each other, and their ſheaths were of a darkiſh colour, ſo that he could not eaſily perceive the *Animalcula*; and moreover, they ſeem'd to be compos'd of globules: M. *Leewenhoeck* likewiſe obſerved other ſheaths, that were ſeveral degrees leſs than thoſe before-mention'd, and as tranſparent as glaſs, ſo that a perſon might plainly ſee the *Animalcula* lying within them; P*def* repreſents the ſheath with the little worm P*df* therein; O*gh* ſhews a ſheath with half the body of the *Animalculum gh* protruded out of it; and in which, by reaſon of its exceeding ſmallneſs, the wheels could be ſeen but now and then, and that only when its body was extended, which would ſoon contract itſelf; moreover, he obſerved one of theſe *Animalcula*, whoſe body was ſometimes extended and ſometimes contracted; and about the middle of its body, which M. *Leewenhoeck* took to be the lower part of its belly, there was another of the ſame kind but ſmaller, whoſe tail ſeem'd to be faſten'd to the other.

Fig.

Fig. 25. ABCDEFGH repreſents an *Animalculum* about twice as big as it appear'd to the naked eye, whilſt it was in the water, and faſtened to the root of the green weeds; A the tail wherewith it faſtens itſelf; CDE repreſents eight horns; whereas, others that were ſmaller had but ſix; the animal is drawn as extended at its full length, whereas when contracted, it was not the fourth part ſo long; Fig. 26. KLM repreſents a ſmall part of one horn; in Fig. 25. is to be ſeen an *Animalculum* BH coming out of the body of a larger one; this M. *Leewenhoeck* took at firſt to be a young *Animalculum* faſten'd by chance to an old one; but obſerving it more narrowly, he ſaw it was a *Partus*; for whereas this *Animalculum* (when he firſt diſcover'd it) had but four very ſmall horns; after the ſpace of 16 hours, it was grown much bigger both in its body and horns; and four hours after that, it was quite excluded its mother's belly; M. *Leewenhoeck* obſerv'd, on the other ſide of the body of the biggeſt *Animalculum*, a round little knob of ſeed between G and I, that from time to time, and in a few hours, grew ſtill bigger, and at laſt grew pointed; and in 13 or 14 hours it became ſo large, that you might ſee two horns upon it; in the ſpace of 24 hours, the laſt mention'd *Animalculum* had acquir'd four horns, one of which was ſmall, the ſecond larger, and the other two were very large, and were more ſtrongly protruded and contracted than the others; three hours after, this *Animalculum* got clear of it's mother: M. *Leewenhoeck* endeavouring to purſue his diſcovery of the generation of theſe animals, wiped off the green weeds from their bodies, the better to make his obſervations; but he found that the *Animalculum* was not only dead, but its horns and part of its body quite waſted: Another *Animalculum*, that had brought forth two young ones, had her body laden with another ſort of *Animalcula*, whoſe ſhape was flat below and roundiſh above, and which he obſerved in moſt waters; and theſe were above 1000 times leſs than thoſe they crawl'd upon, and hinder'd their moving; but a much larger *Animalculum*, whoſe body was almoſt round, teas'd one of the aforeſaid *Animalcula*, not only by running upon its body but by clinging ſo faſt to one of its horns, that whatever effort the other made to get rid of it, ſhe could not ſhake it off; and at laſt, M. *Leewenhoeck* found ſhe had loſt one of her horns in the ſcuffle; that which ſeem'd very ſurpriſing to M. *Leewenhoeck* was, that the ſaid *Animalcula* would ſometimes extend their horns to ſo great a length, that thro' the microſcope, they ſeem'd to be ſeveral fathoms in length, as repreſented in Fig. 27. NOP, wherein are like-

likewiſe obſervable the knotty protuberances, as in Fig. 27. K L M; theſe protuberances ſeem to be compos'd of ſeven round globules plac'd together; *viz.* one in the middle, which was more prominent than the reſt, and the others like a roſe round it; M. *Leewenhoeck* obſerved in the green weeds abundance of ſurpriſing *Animalcula*; ſome of which feed upon the ſame green ſtuff, and to others of them it ſerved inſtead of ſculking holes to hide themſelves from the fiſh, which would otherwiſe devour them.

To return to the generation of the above-mention'd green weeds; M. *Leewenhoeck* had ſeveral times obſerved, that moſt of the roots are thickeſt at the extremity, and provided with a great many parts that look like flowers to the eye, with long pipes therein, which he takes to be a gummy excrementitious matter, that by overſpreading the whole root, cauſes it to die, or wither.

M. *Leewenhoeck* had often diſſected ſome of theſe ſmall weeds, which had never produced any others; and he extracted young weeds out of them, which were ſo very ſmall, that they eſcaped his naked eye; let us ſuppoſe that Fig. 23. A B C is compos'd of three entire weeds, of which that part mark'd A we will call the mother-plant, from whence proceed ſeveral roots; firſt the plant B is immediately produced by the ſaid mother-plant, and join'd to it by a fibre, which as it grows, conveys nouriſhment to it, till it is provided with roots of its own; before the weed B is arriv'd at its full growth, A has brought forth another mark'd C, and that likewiſe has no root; now, if we ſhould diſſect one of thoſe weeds, tho' they were never ſo ſmall, we ſhall find young weeds within them; M. *Leewenhoeck* opened one of theſe immature weeds, and took out ſuch an embryo as is before deſcribed; and placing it before his microſcope, it was immediately drawn, before its moiſture ſhould exhale; for if that ſhould happen, the veſſels, thro' which it receives its increaſe could not be eaſily deſcribed.

Fig. 30. repreſents a weed M. *Leewenhoeck* had extracted out of another, of the bigneſs of C in Fig. 23; this weed receiv'd its nouriſhment by that part mark'd S T; between S T inwards you may obſerve five ſmall particles, which M. *Leewenhoeck* ſuppoſes alſo to be young weeds; and that part which lies between S T outwards was likewiſe a young weed, which had as round and as entire a ſhape as Q R S T itſelf; ſo that from hence it appears, that all theſe green weeds proceed

ceed from a ſeminal matter, as well as other plants do; that he might ſatisfy himſelf ſtill more fully, he caus'd ſome of theſe weeds to be taken out of a ditch; but the largeſt of them were much ſmaller than the above-mentioned ones, but their leaves were much thicker; having examin'd theſe weeds, he found, that tho' they were arriv'd to their full growth, they had but two roots, which were longer than the roots of the firſt weed; and upon viewing the ſmaller weeds, he could perceive that they had ſeveral, tho' very ſhort roots; whilſt M. *Leewenhoeck* obſerv'd the laſt weed, he ſaw a great number of *Animalcula* ſwimming in circles thro' the water, and they lay ſo thick together, that even to the naked eye they appear'd like a cloud; M. *Leewenhoeck* had never ſeen any of theſe *Animalcula* in other waters, and next day they were all gone; there were a great many ſpecies of theſe *Animalcula*, and each had their different motions, and they were all ſo ſmall as to eſcape the naked eye; amongſt theſe, he obſerved ſome that were much larger than the reſt, and were coupled together, in which action they lay very quiet on the ſides of the glaſs, till a larger ſort interrupted them; whilſt they lay quiet, he could eaſily ſee thoſe inſtruments by which they move, as alſo the motion of ſeveral parts of their bodies, which ſome would take for the circulation of the blood; but M. *Leewenhoeck* rather ſuppoſes it to be the chyle in the guts; theſe *Animalcula* were ſo large, that they might be ſeen in clear water, and in a glaſs-tube; amongſt ſeveral of this ſort he could perceive ſome as big as little grains of ſand, and as compleatly formed as garden-ſpiders.

A Water-ſpout *at* Hatfield; *by Mr.* Abraham de la Pryme. Phil. Tranſ. N° 284. p. 1331.

THO' the weather in *June* had been in this part of the country exceeding wet and cool, yet monday the 21ſt of the ſaid month was pretty warm, and about two o'clock that afternoon, no wind ſtirring below, tho' it was ſomewhat ſtormy higher up in the air, the clouds began to be mightily agitated and driven together; whereupon they became very black, and were very viſibly hurried round, from whence there proceeded a moſt audible whirling noiſe; ſome time after, there deſcended a long tube or water-ſpout from the center of the congregated clouds, wherein was a ſwift ſpiral motion like that of a ſcrew, or the *Cochlea Archimedis* when in motion; it proceeded ſlowly from weſt to north-eaſt, broke down a large oak or two,

frighten'd the labourers out of the field, and made others lie flat upon their faces to eſcape being whirled about and killed, as they ſaw had happen'd to ſeveral jack-daws, who were ſuddenly ſnatch'd up, carried out of ſight, and then thrown a great way off; at length it paſs'd over the town of *Hatfield*, filling the whole air with the thatch it took off from ſome of the houſes; then touching upon a corner of the church, it tore up ſeveral ſheets of lead, and roll'd them together in a ſtrange manner; and ſoon after, it diſſolved and vaniſh'd, without doing any further miſchief; there was nothing more extraordinary in this water-ſpout, than in that which Mr. *de la Pryme* gave an account of Phil. Tranſ. N° 281. p. 1248; and by all the obſervations he could make of both, he found that had they been at ſea, and join'd to the ſurface thereof, they would have carried up a vaſt quantity of water into the clouds; and the tubes would then have become much more ſtrong and opaque than they were, and have continu'd much longer.

It is commonly ſaid, that at ſea the water collects, and bubbles up a foot or two high under theſe ſpouts before they join; but this is a miſtake, owing to the pellucidity and fineneſs of thoſe tubes, which undoubtedly touch the ſurface of the ſea, before any conſiderable motion can be produced therein; and that when the tube begins to fill with water, it then becomes opaque and viſible; as for the reaſon of their diſſolving of themſelves, after that they have ſuck'd up a great quantity of water, Mr. *de la Pryme* ſuppoſes it to be owing to the great quantity of water carried up, which muſt needs thicken the clouds, impede their motion, and by that means diſſolve the tubes.

Microſcopical *Obſervations.* Phil. Tranſ. N° 284. p. 1357.

THE contrivance of the ivory-box and hollow ſcrew for approach, in Mr. *Wilſon*'s new ſet of microſcopes, together with the illuminating convex at the extremity thereof, is of great ſervice both by day and candle-light; as alſo the ſliders, with the plain and concave glaſs-plates for objects, are very convenient; but the braſs-tool wants improvement, and is capable thereof; *viz.* a fine threaded ſteel-ſcrew for a more ſteady approach, and ſome new turns and motions to the arm which carries the object, *&c.* alſo a braſs-arm might be made to ſlide up and down on the ſquare rod of the deep microſcope, to which might be fix'd with a ſcrew either the ivory-box, or the handle of the braſs-tool, to be ſet by that means in a fixed poſi-

poſition to any height, or inclination requir'd, which will be very neceſſary, when an illuminating glaſs is applied to either.

As for the glaſſes themſelves, they are very good and well wrought, and are far ſuperior to any of *Mellins*; eſpecially, the greateſt magnifiers magnify more, and at the ſame time ſhew an object more diſtinctly than his do; the greateſt magnifier ſhews to any eye a hair of the head conſiderably above an inch in diameter, and ſome eyes ſee it at leaſt two inches; but, ſuppoſing it a bare inch, and that (as Dr. *Hook* affirms) 640 hairs breadth make an inch; the length and breadth of an object will, by this magnifier be enlarged 640 times, the ſurface 409,600 times, and the ſolidity 262,144,000 times: But the beſt of our glaſſes muſt needs fall ſhort in power and goodneſs of M. *Leewenhoeck*'s; and tho' ſeveral people queſtion the truth of his relations, yet this gentleman affirms, that as far as he was able to follow him (and he tried ſeveral of M. *Leewenhoeck*'s experiments) he always found him faithful in matters of fact; and therefore, he does not queſtion his veracity in other things.

This gentleman firſt tried Mr. *Wilſon*'s glaſſes, with a live louſe; and in it he could plainly ſee the motion of the muſcles, when it ſtirr'd its legs; all which are joined in an oblong dark ſpot in the middle of its breaſt, where all the tendons ſeem to unite; the like motion of the muſcles is alſo viſible in the head, when it moves its horns, as alſo in the ſeveral articulations of its legs; he alſo ſaw diſtinctly a great many various ramifications of arteries and veins, and the pulſe regularly beating in ſeveral arteries; but, the moſt ſurpriſing ſight is the periſtaltic motion of the inteſtines, which is continued from the ſtomach thro' all the guts to the *Anus*; he alſo obſerved the like periſtaltic motion in a flea, and in ſeveral ſorts of ſmall tranſparent maggots and caterpillars: This gentleman found that a mite was not ſo tranſparent as he expected; however, he plainly ſaw, that all the briſtles on the body of one of them (which to a common ſingle glaſs, and to the greateſt magnifier of his three glaſſed microſcope look'd like plain ſmooth hairs) were, when viewed with a large magnifier, all ſpicated, or bearded like the ear on the ſeed-head of ſome graſs, ſomewhat reſembling Plate VII. Fig. A; and every briſtle on the whole body and legs, both long and ſhort, had the like formation; yet all mites are not ſo, for of ſeven or eight he had incloſed together, he found but one whoſe briſtles were of this make, in the reſt the horns only were

ſpicated; whether they were of different ſpecies, or rather only of different ſexes, he could not determine; but, they were all taken out of the ſame cheeſe at the ſame time, and were in other parts very like; their mouths open'd horizontally to the right and left, like that of a waſp; and after having been ſhut up together for ſome days, he found ſome dead, and the ſurvivors preying on them, which gave him an opportunity of obſerving their manner of feeding, which was very remarkable; for, they thruſt one mandible forwards, and drew the other backwards at the ſame time, and thus they do alternately, by which means they ſeem to grind their food: When you bring one of the greateſt magnifiers to obſerve a mite, or the like minute animal, you muſt lay him on a thin *Muſcovy* plate in one of the ſliders, and cover him with a concave, taking good care not to cruſh the object between the plates in your approach.

This gentleman pulled off a handful of muſcles, which ſtuck to a piece of a rock, cover'd by the ſea every tide; in theſe he found, that the organs by which they faſten ſo firmly to a ſtone, that even a ſtorm will not waſh them off, were threads which proceeded from that part called the beard of the muſcle, and which had on their extremity a flat ſpungy ſubſtance, that adhered only by impoſition, and they are very well deſcribed and repreſented by M. *Leewenhoeck*; he alſo viewed and examined the inhabitants of thoſe little white ſhells, which ſtick like puſtules on muſcle-ſhells, as alſo on lobſters, oiſters, ſtones, *&c.* M. *Leewenhoeck*'s figure of one of thoſe little animals extracted out of its ſhell, is very accurate; only, that in the 12 long branches growing from the head, the briſtles are there repreſented coming out quite round on each joint of every branch; whereas, they grow only on the inſide (all the hinder part being perfectly bare) and look not unlike a ruffled feather ſtrip'd on one ſide; this gentleman could not gueſs at the uſe of theſe curious ramifications, unleſs they ſerve to draw in the animal's food, which cannot move out of its place; for, having kept them alive in ſea-water, he ſaw them often put out thoſe branches thro' the ſlit of the *Operculum*, which cloſes the top of the ſhell, and draw them in again; this ſhell naturaliſts call a *Balanus*, and claſs it with the *Concha anatifera*: He took one of theſe muſcles out of the ſhell, and expoſing it to the microſcope on a thin plate of *Muſcovy* glaſs, he held it to the light of a candle, and he ſaw in the thinner parts a vaſt number of veins and arteries, and the

the blood circulating in them more diſtinctly than ever he had ſeen it in any other animal; for he had this advantage in the obſervation, that the object lay always quiet, without changing place, and his plate was ſo thin, that he could bring to it what magnifiers he pleaſed, and look upon it without diſturbance; for whereas, other animals will not eaſily be brought to lie ſtill any conſiderable time, and will not live long when expoſed to a microſcope; this lay always in the ſame poſition, and the motion of the blood continued with little alteration for ſix or ſeven hours, and might have laſted much longer, only by keeping the object moiſtened with ſea-water; he repeated the ſame experiment for two or three days with ſome of the remaining muſcles, with little difference in the ſucceſs: He eſpied a ſmall worm running amongſt ſome fruit, which he could perceive to have a great number of legs; it was not half an inch long, and its body was not thicker than a hog's briſtle; this inſect he put alive into a ſmall tube, and he found it a perfect *Scolopendra*, whoſe body conſiſted of 60 inciſures; at every one of which, there was a pair of legs, one on each ſide, and each leg had five articulations; on his head were two horns, each of 16 joints, and under it a pair of *Forcipes*, red, crooked, and pointed, like the talons of a hawk, and this gentleman often ſaw him open and ſhut them, and wipe his horns thro' them; theſe *Forcipes* are not unlike, and probably are for the ſame uſe as thoſe on a ſpider's head; but they are hardly ſeen (becauſe, generally kept cloſe) in a live ſpider, but you may readily find them open, and in their perfect ſhape, in a ſpider's *Exuviæ*, or caſt-coat.

This gentleman found a ſmall black flat tick, ſtick on his arm, and it had got its fore-part ſo far into the ſkin, that he had much a-do to ſeparate it with the point of a needle, ſo as to preſerve it entire and unhurt; he obſerved its trunk Fig. B, ſhaped not unlike the jagged *Proboſcis* of the *Serra Piſcis*; the fore-part *a* reſembling the extremity of a broad-pointed ſword, is clear and tranſparent, and has three teeth on each edge, below which there comes out another ſerrated part *b b*, on each ſide, almoſt at right angles; but when you view the back, this is partly hid by a thick horn *c* on the ſide of the head; one of the horns was broken off at *d*, and then it appeared as in the annex'd figure, which repreſents the fore-part of this tick; he afterwards examined the *Proboſcis* of dog-ticks, to ſee if they had the like conformation; and he found their appearance as in Fig. B 2; the *Proboſcis a* being covered in ſuch a manner with the two thick horns *b b*, that the

the ſerrated edges could not be perceived; but, ſeparating the horns with ſome difficulty, they appear'd in the poſition of Fig. B 3; and then he could plainly ſee eight teeth, or jaggs on each ſide, as here expreſſed; but the *Proboſcis* of the dog-tick had not the additional ſerrated part, which is in the wood-tick; he could alſo perceive a tube, or canal, run thro' the *Proboſcis*, and ſee ſome bubbles move up and down therein, which are alſo repreſented by *a* in this figure.

This gentleman found ſome of the *Animalcula* in pepper-water almoſt incredibly minute, which appeared even to his greateſt magnifiers not ſo big as a mite does to the naked eye; and in the largeſt ſort, he could plainly ſee the little feet (by which they perform ſuch briſk motions), which he never could find before; he alſo diſcovered one ſort of *Animalcula*, which were very ſlender long worms, wherewith his pepper-water was exceedingly repleniſh'd; they were all of the ſame thickneſs, but their length was various, ſome being twice, and ſome thrice as long as others; and at a medium, he judged the proportion of their length to their breadth to be at leaſt as 50 to 1; even to the greateſt magnifiers they appeared as ſhreds of horſe-hair do to the naked eye, from a quarter to three quarters of an inch long; upon a modeſt computation, their thickneſs was not the 100th part of an hair's breadth; and conſequently, if you imagine a hair of your head ſplit into above 7800 equal fibres, each fibre would be as thick as one of theſe *Animalcula*; their motion is equable and ſlow, and generally they wave their bodies but little in their progreſſion, tho' they ſometimes make greater undulations; but what is more remarkable, they ſwim with the ſame facility both backwards and forwards; ſo that he could not diſtinguiſh at which extremity the head was; and he has ſeen the ſame worm go forwards with one extremity, and back again with the other extremity foremoſt above 20 times together; and ſometimes they would, like leeches, fix one extremity on the glaſs plate, (on which the water was laid) and move the looſe part of their bodies round about very oddly; theſe he calls capillary eels, which are repreſented by Fig. C, according to the ſeveral poſitions they appeared to a great magnifier to ſwim in. The powder of the *Fungus pulverulentus*, or puff-ball, is the minuteſt powder this gentleman ever ſaw; when cruſhed, it appears to the naked eye like a ſmoke, or vapour; and with a common microſcope the particles cannot be diſtinguiſhed; but, when viewed with the greateſt magnifiers, each grain is viſible and exactly ſimilar, and appears a perfect ſpherule of

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an orange-colour, ſomewhat tranſparent, whoſe axis is not above the 50th part of the diameter of a hair; ſo that a cubical veſſel of an hair's breadth on each ſide, would contain 125,000 of them; this was the ſize of the powder of that *Fungus*, which is bigger than one's two fiſts put together; and he obſerved, in another puff-ball of the ſize of a ſmall crab (which he takes to be a different ſpecies) that all the globules were darker, and that each had a little tail, or ſtalk, fix'd thereto; he at firſt imagined, that theſe tho' ſo minute, might be ſeeds, but he was ſoon undeceived, upon finding that the ſmut of blaſted corn was compoſed of the like regular globules, and of the ſame ſize; his method of obſerving theſe and the like ſorts of powder, was by breathing gently on a thin *Muſcovy* plate, and then covering it deep with the powder, to blow it off again; for enough would adhere, and the particles would not lie in confuſion: This gentleman found a grub, of which a great number adhered to nettle-leaves; it was an exceeding thin animal, had a ſort of a covering all over its back, like a broad ſhield, under which he lay like a tortoiſe, and was all over beſet and fringed round with ſpikes.

A buck being killed in rutting time, about the end of *September*, this gentleman took out one of the *Teſtes*, with the adjoining ſeminal veſſels, and he found the *Vaſa Deferentia* very turgid, and full of a milky fluid; after various methods of viewing this liquor, he ſaw the *Animalcula* in vaſt numbers, as plain as tadpoles appear to the naked eye, moving very briſkly in ſeveral poſitions; the greateſt difficulty, was to lay them thin enough before the microſcope; for, when the matter is too thick, you ſee nothing diſtinctly, only a confuſed motion; and when it is ſpread thin, it dries directly, ſo that you muſt be very quick, elſe you loſe your labour: He diluted ſome of the *Semen* with warm water, juſt ſo much as would change its colour a little; and by that means he could ſee them, even with ſmall magnifiers, more diſtinct and ſeparate; and then they kept their ſhapes for a long time, even till next day when put into a ſmall tube, but they were without any motion; to his beſt glaſſes they appeared about the ſize, and in the poſitions repreſented by Fig. D.

In his obſervations of the *Animalcula* in waters, he found ſeveral of the ſame ſpecies in the different infuſions, and even in waters that have been expoſed, eſpecially in *September*, any time without any particular mixture, ſuch as are found in the cavity of a cabbage-leaf, or on the *Dipſacus*, &c. and he is confi-

confident, that ſeveral of theſe are the ſame animals under different appearances; for he obſerved ſuch a regular proceſs in them, and conſtant uniformity in their appearance, that he is of opinion moſt of them are produced from the ſpawn of ſome inviſible volatile parents, and generated like gnats, and ſeveral other ſorts of flies, which are bred, and undergo various changes in the water, before they take wing; probably, ſome of them may originally be water-inſects, or fiſh *ſui Generis*, and are ſmall enough to be raiſed in ſpawn with the vapours, and to fall down again in rain, and grow and breed in water when kept; and this will ſeem leſs ſurpriſing; becauſe this gentleman aſſures us, he has ſeen ſome fiſhes as ſmall as cheeſe-mites, of different ſpecies, and admirably form'd; and which are of the cruſtaceous kind, ſhell'd with ſeveral joints, having very long horns, fringed tails, and a great many legs, like ſhrimps, curiouſly contriv'd; and that ſome of theſe carry their eggs, or ſpawn, under their tails, in one bag; another ſort in two diſtinct bags, and ſome kinds on the fringes of their legs like lobſters.

The *Animalcula* in pepper-water, repreſented by Fig. E, are very common, and are deſcribed by M. *Leewenhoeck*. This gentleman has ſeen the tails of ſome of them 9 or 10 times longer than their bodies (which are about $\frac{1}{5}$ of a hair's breadth) but generally they are 4 or 5 times as long; as they move, they will often twitch up the tail in the poſition as mark'd at *b*; and this ſpring is ſo ſtrong, that when the tail is intangled (as it generally is) by the extremity, they bring back their whole bodies by the jerk and convolution of the tail, which quickly returns to its firſt ſtreightneſs; to a good glaſs, the extremity of the tail ſeems to have a knob on it as in *a*, and the folding appears as in *b*; but upon examining the knob with one of the greateſt magnifiers, he found it to be only a cloſe ſpiral convolution, like the worm of a bottle-ſcrew; and that the whole tail, when twitched up, was alſo a ſpiral; this appearance to the great magnifier, is repreſented by *c* and *d*; he has alſo ſeen them ſometimes, as in *e*; and he has further obſerved, that when theſe lie ſtill, they thruſt out a fringed or bearded tongue, which they can draw in again; and that a rapid ſtream runs conſtantly towards their fore-parts, as if they drew in water; but he rather ſuppoſes, that this current is occaſioned by a nimble tremulous motion of ſome minute fins or legs, which his glaſſes could not diſcover: Thoſe *Animalcula* mark'd F, alſo abound in all the waters, and are the

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largeſt of all; and he could ſee them in a good light and poſition (without any other aſſiſtance) with his naked eye, their length being about a hair's breadth; theſe have a very quick motion, and are perpetually beating about like a ſpaniel in the fields; and by their frequent turns and returns, ſudden ſtops, and caſting off, they ſeem to be always hunting for prey; their bodies are very thin; that which this gentleman takes to be the back, is much darker than the other ſide; and you ſhall ſee them frequently turn ſometimes one ſide, and ſometimes the other towards your eye, and many times you may ſee part of each; their edges are, as it were, fringed with a great number of very minute feet, which are moſt conſpicuous about the head and hinder parts, where are alſo ſome briſtles longer than the feet, which appear like a tail; *a* repreſents one of theſe with the back, and *b* one with the belly towards you; and in *c* and *d* it is repreſented, as it often appears in other poſitions; he put ſome ſhort ſhreads of his hair into their water to compare their magnitude by, and he ſaw that they could uſe their feet in running, as well as ſwimming; for, they would often ſtand on a hair, and go on it backwards and forwards from one extremity to the other, often ſtooping down, and bending into ſeveral poſtures; among theſe, there is generally another ſort (but not above $\frac{1}{3}$ of their ſize) whoſe feet are alſo very viſible; ſome of them are ſhap'd almoſt like a flounder, and others are rounder behind; for, by their motions and actions, he judged them to be the ſame animals; theſe alſo will ſtand, and run on a hair, or on any ſediment in the water; they are repreſented by *a b*, Fig. G; he has likewiſe ſeen them double as at *c*, and ſo go forwards, like flies *in Coitu*; he at firſt took them to be a ſingle animal of that ſhape, but afterwards, he often obſerved them both join and ſeparate, and two of them following a third, ſometimes the firſt, and ſometimes the ſecond laying hold of it, and driving off the other: The little feet of theſe *Animalcula* are moſt diſtinguiſhable, when the water is juſt evaporating; for, being then ſtranded, they cannot change their places; and at that time, you may ſee them move their feet nimbly, and diſtinguiſh them ſome little while after the water is evaporated.

This gentleman thought, that thoſe he calls capillary eels, had been peculiar to pepper-water; but in *October*, he obſerved the ſame (tho' but few) in ſome ſtanding water, which drain'd from a horſe-dung-hill; this liquor was mum-colour'd, and the moſt pregnant of all he had ever ſeen; and it would

ſeem incredible, what a prodigious number of *Animalcula* of all ſorts, he computed to be in a quantity of it as big as a pepper-corn; for, they appeared as thick as a ſwarm of bees, or ants on a hillock; ſo that he was obliged to dilute the water, to obſerve the particular ſorts; here he found not only almoſt all the *Animalcula*, he had ſeen in the other infuſions, but ſeveral ſorts which he had never met with before; amongſt them were in great numbers, ſuch as are repreſented in Fig. H; their extreme parts appeared bright, and the middle dark, and ſeemed to be beſet with briſtles; their tails were pointed, with a long ſprig at their extremity; their motion was ſlow, and wadling; there was alſo a great number of a kind of eels, which appeared moſt diſtinctly, when the water was almoſt evaporated, making briſk ſhoots, and having a wriggling motion; they were of different lengths, and about the thickneſs of what he calls capillary ells; ſome of them, together with ſome of the capillary eels amongſt them, are repreſented in Fig. K, the better to judge of their proportions; he preſerved ſome of this dung-hill-water by him ſeven or eight days; and he found the number of theſe little eels to decreaſe daily, till he could hardly find one therein, tho' they were as numerous as before in the water newly taken up; and on the contrary, he obſerv'd great numbers in the water he had preſerved, which were very ſcarce in the freſh water; amongſt theſe was one ſort very ſingular in its ſhape and motions; its body was ſpherical, only pointed a little like a pear; and it ſeemed very pliable, like a bladder fill'd with water, in which was a vaſt number of dark particles in a confuſed agitation; their moſt remarkable motion was a revolving one; they would ſometimes turn above 100 times in a minute, ſometimes not half ſo faſt the ſame way, and then ſtop, and turn the contrary way; and all this without moving a hair's breadth out of their places; they alſo would go forwards, turn and return, and fetch a large compaſs with ſeveral deviations; and in their progreſſion they always kept (even in the ſhorteſt turns) their pointed extremity foremoſt, the revolving motion ſtill continuing; when the water is evaporated, their ſkin breaks, and the incloſed liquor diffuſes itſelf; their ſhapes are repreſented in Fig. L; and they are of various magnitudes: There is another ſort, repreſented in Fig. M, in great numbers, which are near as long as the largeſt kind formerly mention'd; theſe have briſk motions, and are very active; and they have ſeveral feet in the fore parts, very viſible; they will often contract, and

again

again dilate themſelves as they ſwim; but eſpecially when the water is evaporated, they will ſkrink up into a globular figure, and then their feet ſtand out, which you may obſerve to move very nimbly a conſiderable time after; theſe alſo are of various ſizes; *a a* ſhews them at their length, and *b b* when contracted; Fig. N repreſents another animal, not uncommon amongſt the reſt, which is as large as the former; and in its motion, which is very nimble, it always keeps its ſharp extremity foremoſt; he obſerved ſome variety in theſe (tho' he takes them to be of the ſame ſpecies) ſome being clear, and curiouſly ſtriated from the point to the thick extremity; others having only the fore-part clear, and the bottle dark, as is ſhewn at *a* and *b*; but he could not, by any glaſs, diſcover the organs by which they mov'd.

This gentleman found a curious mechaniſm in a ſmall diving-inſect, which inhabits ſtanding waters; it is like a ſmall fly, with a head like a houſe-cricket, but, inſtead of wings, it has two paddles on the ſhoulders, and on the extremity of the hinder legs, which are longer than the other four, inſtead of feet and claws there are perfect oars; he alſo obſerved, in two or three ſorts of flies, that behind the eyes, on the top of the head, were placed three protuberances (in an equi-lateral triangle with the foremoſt point) with a black ſhining globe in each, like a ball in a ſocket; and they are diſpoſed in ſuch a manner, as if they were form'd to look backwards; they are perfectly ſmooth, and without thoſe hemiſpherical diviſions, viſible in the *Cornea* of the eyes of the fly and beetle kinds, but appear more like thoſe of a ſpider.

This gentleman tried ſeveral methods of killing the *Animalcula* before-mentioned; as by mixing ſalts, ſpirits, and acids, *&c.* with their water; the leaſt touch of which would immediately deprive them of motion and life; but he could never ſucceed in any experiment of recovering or reviving them, after the water was evaporated, by the addition of freſh water; tho' ſome have affirmed, they may be revived by that means, even an hour after; and others, that they will recover after the water is boiled; ſeveral of theſe he mentioned, burſt when the water was evaporated; and tho' ſome keep their ſhapes a little while, yet they alſo alter in a few minutes, and he cannot imagine that they are recoverable.

An Apoſtemation *of the* Lungs *cured*; *by Dr.* Wright. Phil. Tranſ. N° 285. p. 1372.

MRS. *Jane Terry* was about 18 years of age, of a freſh complexion, and pretty fleſhy, when her relations apprehending ſhe might have the ſmall-pox, removed her to a nurſe's houſe, where ſhe had the diſtinct ſort very kindly; her caſe proceeded ſo very well (as they imagin'd) that no phyſician was called to her, till they began to ſhell; only, that for ſome days before, ſhe had a little difficulty in her breathing, which gradually increaſed, till ſhe began to throw up ſome blood, which was about the ſeventh day from their firſt appearing, and was accompanied with theſe following circumſtances; it had increaſed every day, for three days before the Dr. ſaw her, ſhe cough'd and brought up a viſcous phlegm, ſuch as patients vomit, when their ſtomachs are very foul; only, that as mere phlegm is white, this was all as red as blood, not ſtreak'd with blood, or having a mixture of white phlegm, but ſo deeply tinged, that it ſeem'd to be all blood; only, that it would not flow as blood does, when it is hot; nor would it coagulate as blood does, when it is cold, but hung from the baſons when pour'd out, as vomited phlegm does; and herein it differ'd from all the bloody expectorations the Dr. ever ſaw, excepting one Mr. *Jones* at *Kenſington*, who cough'd the like bloody-colour'd *Pituita*, but in a much leſs quantity; for, Mrs. *Terry* threw up, for ſome days, above a pint in 24 hours; and tho' a leſs, yet a conſiderable quantity afterwards; Mrs. *Terry*'s had a very ſtrong ſmell, but Mr. *Jones*'s had none at all; after ſome weeks the patient recovered, regained her fleſh, which had been waſted in her illneſs; her *Menſes* returned, and ſhe continued very well from *July* till near *Chriſtmas*: In *January* the Dr. was carried to ſee her, when ſhe gave the following account of herſelf; that about three weeks before *Chriſtmas* ſhe found herſelf a little ſhort-winded, which increaſed daily, with a heavineſs and weight in her left ſide; that ſhe lay well on the left ſide, but when ſhe turned to lie on her right, ſhe felt, as if a weight fell from the left to the right ſide, which gave her a ſhortneſs of breath, and made her cough; thus it continued increaſing till *Chriſtmas*, when ſhe began to raiſe a conſiderable quantity of ſtrong ſtinking *Pus*; ſhe ſaid, ſhe eat her victuals well enough all this time, and was not feveriſh; at firſt, ſhe was under the care of another phyſician, who told her relations, it

was

was an ulcer in her lungs, which he believed incurable; upon which, they again committed her to Dr. *Wright*'s care; when he ſaw her, which was towards the middle of *January*, ſhe often threw up a conſiderable quantity of a ſtinking offenſive *Pus*, which was as fluid as the *Pus* of other parts; her fleſh was a little fallen, but without any fever; ſhe eat and ſlept pretty well, and had her *Catamenia* regularly; the Dr. preſcribed ſuch medicines, as abated that purulent expectoration ſeveral times, and ſhe often gave him hopes of her recovery, ſhe continuing to have her *Menſes* regularly, and being ſtill free from a hectic fever; but upon every little cold, ſhe again diſcharged that fetid *Pus* in a conſiderable quantity; ſhe generally continued pretty free from coughing ſeveral hours together, till ſhe perceived ſomething of a fullneſs in her breaſt, which would oblige her to cough; and after ſhe had once begun to diſcharge, ſhe could not ceaſe, till ſhe had brought up two ſpoonfuls, or more, of that fetid *Pus*; and this ſhe did chiefly in the morning, afternoon, and at night; the Dr. apprehended ſhe had an abſceſs in the left lobe of her lungs, and made her lie upon the bed, with her head reaching to the chamber-floor, leaning upon her left arm; in this poſture, ſhe could at any time, after a little coughing, ſet the *Pus* a running out at her mouth, till the whole was diſcharged; then ſhe would get up, and ſeem to be well, till it was almoſt filled again.

In the beginning of *May*, Drs. *Torleſſe* and *Pitts* ſeeing her lie in the poſture Dr. *Wright* had deſcribed: This expectorating of ſtinking *Pus* made it ſo apparent, that there was an ulcer in her lungs, that it was reſolved upon to make an apertion in her ſide, where it was apprehended the lungs adhered thereto; for that ſeemed unqueſtionable, from the poſture of diſcharging the purulent matter, and from ſome little pain ſhe felt in her ſide; about a week before Mr. *Cowper* was ſent for to perform the operation, the *Pus* had again begun to increaſe, and ſhe was taken with a chillneſs, after which her pulſe became a little quicker, and when Mr. *Cowper* applied the cauſtic, ſhe was a little feveriſh; this feveriſh ſtate increaſed every day, and ſome days after a raſh appeared, which laſted about 14 days before it was quite gone, and it left her in a hectic, with a redneſs in her cheeks towards evening, night ſweats, a continual looſeneſs, extreme waſting of her fleſh, and at length a ſwelling in her legs, tho' ſhe kept her bed; ſome little knots were felt betwixt the 7th and 8th rib, which,

which, with other circumſtances, made us conclude the adheſion was in that part; and we would have applied the cauſtic there, but that it would certainly have ſpread to the glands of her left breaſt, which made us lay it on between the ſixth and ſeventh ribs, reckoning them upwards; Mr. *Cowper* took it off as ſoon as he could, and with his knife he gently paſs'd thro' into the cavity of her *Thorax*, whence iſſu'd a bloody water, but no *Pus*; by bending his probe he found the adheſion reach'd to the lower edge of the ſeventh rib; and before the *Eſchar* was ſeparated, the *Pus* began to flow at every dreſſing, and ſo continu'd, gradually abating, till the ulcer was cur'd; during which, a part of the inſide of that rib, above an inch long, exfoliated, and after that, another leſſer piece of the outſide of the rib; towards the latter end of the cure, the patient complained very much of a pain at the *Cartilago enſiformis*, which was ſo great, that ſhe ſometimes pluck'd out the hollow tent, which we ſuppos'd might be occaſion'd by its preſſing upon the nerve; during the firſt ſeven or eight days of her raſh, ſhe brought up very little if any of that *Pus*; nor did it diſcharge itſelf any other way than by the orifice; nor was there a collection of it in her breaſt, which made Dr. *Wright* apprehend, that the fever did ſo alter the ſtate of her blood, as not to permit it to ſeparate its impurities into the abſceſs: For ſix days before the fever began, the patient had her *Catamenia* very regularly; about *Auguſt* following ſhe was cur'd, her ſide clos'd up, for ſhe could not bear its being converted into an iſſue; by *October* ſhe recovered her fleſh, and her *Catamenia* return'd, which had ceaſed ever ſince *May*; and afterwards ſhe became plump, fleſhy, clear and freſh complexion'd, had little or no cough, no fetid or tabid expectoration, and ſeem'd to be perfectly cur'd, having taken no medicines for ſeveral months.

There are ſeveral circumſtances in this caſe, on which Dr. *Wright* makes the following remarks; *viz.* that there was an ulcer in the lungs, and that it had admitted of a cure, contrary to the general opinion of phyſicians; that this ulcer did contain at leaſt two ſpoonfuls, and muſt have been as large as a hen's egg; that this abſceſs aroſe from a collection of purulent matter, with an indiſcernible if any fever at all; and ſo continu'd from *Chriſtmaſs* to about the 10th of *May* following. The tender membranous or veſicular compoſition of the lungs ſeems to juſtify this opinion; that it is almoſt impoſſible for them to heal, when there is a conſiderable diminution thereof, the continual and indiſpenſable neceſſity of their motion, very much hinder

hindering the coalition of the *Veſiculæ*; ſeveral parts of the body afford a proper cement to unite and repair them, when hurt or diminiſhed; carious and broken bones ſend forth a *Callus*; when the ſkin is conſum'd by ulcers or burnings, the parts afford a *Cicatrix*, which ſupplies pretty well the defect of the ſkin; the lungs ſeparate a viſcid *Pituita*, which will be expanded into fleaks, like a membrane; Mr. *Stringer*, *Sarah Deeping*, and ſome other patients have brought up great quantities of them; and a little boy at *Kenſington* cough'd up ſeveral pipes, form'd exactly like the *Bronchia* and its divarications; and at firſt view it ſeem'd to be the internal membrane; this child two years before, had an ulcer on the right ſide of his lungs, and they adher'd to his back; when Dr. *Wright* ſeparated them he found a *Cicatrix* near three inches long, but very little, if any defect at all in his lungs; ſo that the Dr. is of opinion, that this *Pituita* or *Mucus* ſerves to re-unite the parts of the lungs, when there is a ſolution by an ulcer: Conſumptive perſons generally flatter themſelves, that they have no ulcer in their lungs, becauſe they do not feel a ſoreneſs, as in the ulcers of other parts; and this opinion keeps them from making a timely application to phyſicians, whilſt they might receive a ſpeedy and eaſy cure; when Mr. *Cowper* touch'd the ſound or ulcerated parts of Mrs. *Terry*'s lungs, with his probe or finger, ſhe diſcover'd no ſenſe of feeling, which may confirm the opinion of phyſicians and anatomiſts, that the lungs have little if any ſenſation at all; but when he touch'd her heart with his finger, tho' not the 20th part of a minute, ſhe became very much diſorder'd, pale and ready to faint, which ſhews that nature cannot ſuffer the leaſt alteration in its pulſation, without great prejudice and inconveniency.

It is the opinion of ſome phyſicians, that the fever which attends conſumptive patients, ariſes from ſome particles of the *Pus*, which being receiv'd into the blood, and circulating therewith cauſe that efferveſcence we call an hectic; this patient had no fever from *Chriſtmaſs* to *May*; and then there came a continu'd fever with a raſh, which left her feveriſh every afternoon, together with thoſe ſymptoms which attend a hectic: Dr. *Wright* obſerv'd for ſeveral years, that could he but preſerve his conſumptive patients from that hectic fever, or relieve them who already labour'd under it, he could cure them, tho' their expectoration was very plentiful and foul: The Dr. does not doubt but ſome part of Mrs. *Terry*'s lungs adher'd to her ſide, and it is probable, that a little portion of them did not receive the air in inſpiration; but he believes, that defect was very inconſiderable,

becauſe

becauſe ſhe could run up ſtairs, and was no more diſorder'd in her breathing, than moſt other people are; the eaſy diſcharge of the *Pus*, by her lying down in that poſture, did undoubtedly very much preſerve her lungs, and prevented its breaking thro' the abſceſs into the cavity of the *Thorax*, and putrifying her lungs to a greater degree; *Pus generat Pus* is a noted aphoriſm, and the air-bladders of the lungs are ſo very tender, that they muſt have yielded to the preſſure of the *Pus*, had it lain long in the abſceſs, been only diſcharg'd by violent coughing, and by lying in a proper poſition; Sir *Thomas Proby*, *Sarah Deeping*, and others, have prevented a greater ſolution in their lungs, and either prolong'd their lives ſeveral years, or recover'd their healths by proper medicines; this and other inſtances, make the Dr. eaſily concur with ſome phyſicians in an opinion, that the lungs in ſome families have originally a more tender conſtitution, than in others; Mrs. *Terry*'s aunts were ſubject to great coughs and the phthyſick; her aunt *Fowkes*'s little daughter of about ſeven years old, having a ſlight fever, with ſome ſymptoms of the ſmall-pox, but a great difficulty in breathing; the Dr. adviſ'd bleeding, but ſhe was ſo fat that no vein could be found; next day the ſmall-pox appear'd, which eas'd her lungs a little, on the ſixth night after, ſhe brought up at ſeveral times about ſeven or eight ounces of clear blood, by violent coughing; the Dr. being ſent for, he drew away about ſix ounces of blood, by leeches, which entirely reliev'd her breathing, and ſtopp'd her vomiting of blood; this inſtance being ſo like Mrs. *Terry*'s, confirms what the Dr. ſaid before, that ſo great a loſs of blood will not hinder the regular proceeding of the ſmall pox, which ſhe went thro' very regularly and recover'd perfectly; the Dr. has obſerv'd the ſame effect in other patients, in whom bleeding after eruption was indiſpenſable: The continual motion of Mrs. *Terry*'s *Thorax* in breathing, made the cauſtic ſpread farther than it was deſign'd, or could be prevented; therefore the Dr. prevailed with ſome patients to yield to an apertion by launcet, which in ſome caſes, he takes to be the better method; that little quantity of blood which may poſſibly get into the cavity of the *Thorax*, is eaſily thrown out again by the lungs in inſpiration; as Mrs. *Terry* did the injection every time Mr. *Cowper* us'd it: After that the *Pus* began to flow at the orifice, it leſſen'd the diſcharge at her mouth, and in a ſhort time, the purulent expectoration totally ceas'd.

The

The Same Caſe; *by Mr.* William Cowper. Phil. Tranſ. N° 285. p. 1386.

THE matter or *Pus*, which firſt flow'd from Mrs. *Terry*'s ſide, was of ſo offenſive a ſtench, that the by-ſtanders were oblig'd to quit the chamber; and the nurſe, uſually at the time of dreſſing, and afterwards, was wont to burn roſemary, *&c.* to ſuppreſs it; ſo putrid was the *Pus* that it tarniſhed that extremity of the ſilver probe Mr. *Cowper* paſs'd into the cavity of the abſceſs, as it did the top of a ſilver ſyringe in making injections; there ſeems no room to doubt that the *Pus* which then flow'd from the patient's ſide, came from the ſame cavity the *Pus* did ſhe before cough'd up, when the liquor which was injected thro' the intercoſtals came into her mouth, which ſhe frequently complain'd of; and particularly, of the bitteriſh taſte of the tincture of myrrh Mr. *Cowper* ſometimes us'd in the injections.

Amongſt the various diſorders that affect the parts of human bodies, thoſe of the lungs have been look'd on as none of the leaſt dangerous; and indeed, if obſervations did not aſſure us of the poſſibility of ſucceſs, the commonly known ſtructure of the lungs would afford us, but mean arguments for the ſhift nature makes, in the inſtance Dr. *Wright* has given a deſcription of, as well as ſome other inſtances of the like nature Mr. *Cowper* had met with: A boy in the ninth or tenth year of his age, had for ſome time after a continued fever, been attack'd with an intermitting one; a cough enſu'd, in which he brought up at ſhort intervals, no ſmall quantity of thick purulent ſtinking matter, which diſcharge continu'd on him no leſs than 14 or 15 months before Mr. *Cowper* ſaw him; his phyſicians ordering him iſſues in his back, he made them as uſual; the patient had then a healthful aſpect, his cheeks were florid, and he was very briſk and active; as he came from play, he was bid take a baſon in his hand, and cough as he was wont to do, which he did; wherein Mr. *Cowper* ſaw him diſcharge at his mouth no leſs than four or five ounces of the *Pus* abovemention'd; and this he had been wont to do twice every day; nor did he appear any ways diſorder'd after it, but return'd to play immediately; his phyſicians ſent the patient into the country from whence he came, where in about a twelve-month Mr. *Cowper* heard he died; what ſucceſs the operation practis'd on Mrs. *Terry* would have had on this boy, Mr. *Cowper* cannot determine; tho' he was of opinion it might have been ſafely perform'd on him, and another patient

Mr. *Cowper* was afterwards call'd upon; but he could not obt the conſent of the phyſician that was conſulted.

Another inſtance (in which a conſiderable part of the lun was obſtructed, and conſequently became uſeleſs, ſome time b fore the patient died) was in a girl of 16, who had been ſcr phulous for nine years; the glands about her neck and throat b ing very much indurated as well as diſtended, her lips and no were alſo ſwoln; about a year and a half before her death, ſh cough'd up ſeven or eight ounces of fetid *Pus*, in leſs than hours; on changing the air of *London* for that of the countr together with the uſe of balſamic pectorals, ſhe recover'd healthful look in her face, but continu'd ſomewhat aſthmatic; taking cold, her appetite as well as digeſtion fail'd her, ſhe b came feveriſh and died after a few days indiſpoſition; on openi the *Thorax* Mr. *Cowper* found the lungs adhering to the *Pleu* of the left ſide, in ſuch a manner that they could not be ſeparat without laceration; a portion of one of the left lobes of t lungs, being cut off, ſunk in water, from which part it w likely the matter came, which ſhe formerly cough'd up, th the ulcer was then clos'd, and no appearance of matter was to ſeen in that or any other part of the lungs; the lymphatic gland at the divarication of the wind-pipe, had by their intumeſcen ſo compreſs'd the canal of the left ſide, that it wanted more th two thirds of its proper paſſage for the air.

In theſe and ſome other inſtances, Mr. *Cowper* could produc it is evident, that conſiderable parts of the lungs may be o ſtructed, and yet the perſon ſurvive; but Mrs. *Terry*'s caſe d monſtrates the poſſibility of their recovery, when part of the lungs are totally obſtructed, as muſt happen in ſuch large a ſceſſes; but how the remaining ſound parts of ſuch diſeas'd lun become capable of tranſmitting the whole maſs of blood from t right ventricle of the heart to the left, in equal time and qua tity with the blood that circulates in the reſt of the parts, ſeem not ſo eaſy to account for: Mr. *Cowper*, having often found th water injected by the *Arteria Pulmonalis*, returns readily fro the lungs again by the *Vena Pulmonalis*, tried if melted wa when very hot, would not do the like; which accordingly ſu ceeded in the lungs of two young cats; for after injecting t wax (mix'd with oil of turpentine, and tinged with vermillio by the *Arteria Pulmonalis*, he found it had fill'd the pulmona vein, together with the left auricle, inſomuch that ſome of t wax had reach'd the left ventricle of the heart; ſome of the wa

PLATE. V

Fig. A.



Fig. B.



B. 2.



B. 3.



Fig. C.



Fig. I.



Fig. III.

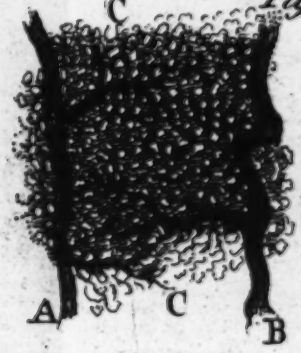




Fig. G.



Fig. N.

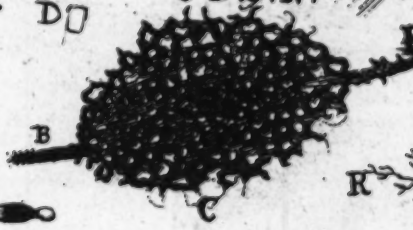


Fig. D.



Fig. H.



Fig. E.

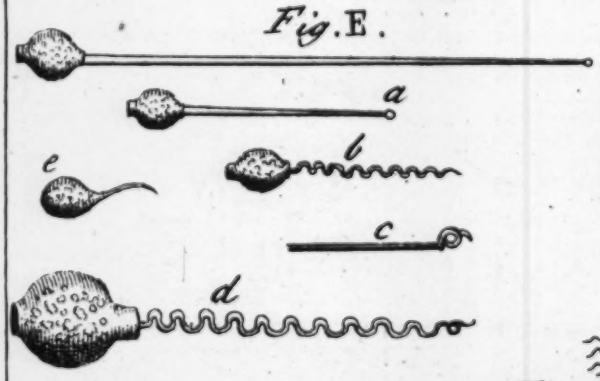


Fig. L.



Fig. V.

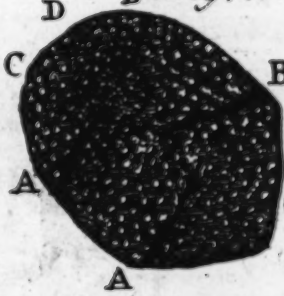


Fig. K.



Fig. M.



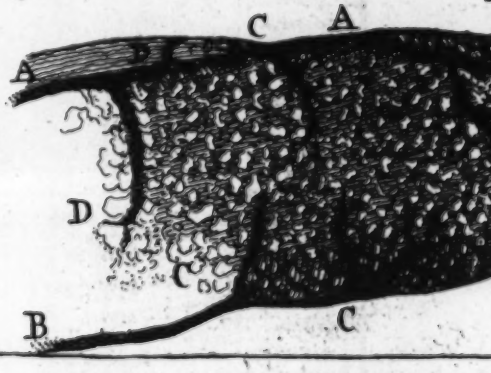
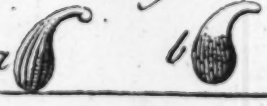


Fig. F.



Fig. N.



G. Smith del.



Hulett Sculp.

was extravaſated, and came into the *Bronchia* and wind-pipe at the ſame time.

In preparing a human heart, by filling its ventricles, auricles, and the trunks of its large blood-veſſels with wax; Mr. *Cowper* found, on injecting the pulmonary arteries and veins with wax differently tinged, that the wax paſs'd from the veins to the arteries, without coming into the *Bronchia*, or being extravaſated, tho' the wax was not injected with near ſo much force as might be; and he could never make wax paſs from the arteries to the veins in human bodies or quadrupeds, unleſs in their lungs, as above, and in the ſpleen and *Penis*; nor did it happen in thoſe parts, but when the wax was impell'd with great force, tho' he conſtantly obſerv'd the communication of the arteries and veins of the ſpleen and *Penis* more open than in other parts, except in the lungs; it were to be wiſh'd Dr. *Morland* had told us in what part of the human body Dr. *Areskin* had made wax paſs from the arteries to the veins, ſo as to demonſtrate their continuation to the naked eye; becauſe Mr. *Cowper* had hitherto found the naked eye unable to diſcover the extremities of the arteries and veins, when the blood itſelf was moving in them, in the tranſparent parts either of the *Omentum* or meſentery of quadrupeds, or in the lungs of live frogs or lizards; or after death, when the blood has been retain'd in their lungs in the following manner; on making an inciſion into the bodies of theſe animals, their lungs will ſtart out, and be diſtended with inſpir'd air; on theſe as quick as you can, paſs a ligature, *i. e.* a wax'd thread, and tie it firmly towards the upper part of the lobe, as near the heart as poſſible; when the lungs of frogs and lizards are dried after being thus diſtended, examine them with Mr. *Wilſon*'s microſcope deſcribed Phil. Tranſ. N° 281, and they will appear as repreſented in Plate VII. Fig. firſt, third, fourth, fifth and ſixth; the firſt and ſecond figures ſhew the difference in the magnitude of the extremities of the veins and arteries of the lungs, and thoſe of the foot of a frog view'd with the ſame microſcope.

The manner of applying the dried lungs here mention'd is thus; take out the glaſſes in the ſlider, or flat piece of ivory mark'd in Fig. 4, *eeff* of the ſaid Tranſaction, and paſte in the holes *ff* parts of the dried lungs, whether of frogs, toads, ſnakes, vipers, or the like animals, that have their lungs veſicated, as well as veſiculated; and by this means you may always keep by you objects of the lungs of thoſe animals; only, you are to obſerve to place the external ſmooth ſurface of the lungs towards your object glaſs; when you view it in the ſame manner,

the extremities of the blood-veſſels of any tranſparent parts of animal bodies may be examin'd by that microſcope.

To return, hence it appears, that the communication between the arteries and veins of the lungs are more open than thoſe of other parts, at leaſt in the feet of frogs; and till it can be ſhewn, that melted wax can be as eaſily injected from the arteries into the veins of other parts in a human body, and in quadrupeds, Mr. *Cowper* is inclined to think, that the communications between the pulmonary arteries and veins in general are more patent, than the arteries and veins of other parts, excepting the ſpleen and *Penis:* This patent communication of the arteries with the veins of the lungs ſhews, how theſe veſſels tranſmit the blood, in equal time and quantity with the blood that moves in the reſt of the blood-veſſels of the whole body in a healthful ſtate; hence it is, that when any of the blood-veſſels of the lungs are ſtraitened or totally compreſs'd, the remaining unobſtructed blood-veſſels are forced to diſcharge more than they were wont to do, and in time theſe veſſels become ſufficiently dilated to ſupply the defect; the like happens in the communicant branches of the arteries of any part, when ſome conſiderable branch or trunk is tied up, as in the operation for curing the aneuriſm, *Phil. Tranſ.* N° 280.

Thus we find, that the ſtructure of the parts of animal bodies is not only ſufficient to perform the ordinary operations of nature, but their organs are ſo wonderfully contriv'd, that notwithſtanding conſiderable parts of thoſe organs are obſtructed, yet their neighbouring parts (as the blood-veſſels in the caſe before us) become capable of ſupplying the defect; and this indeed, exacts our gratitude, as well as admiration of the divine architect.

Fig. 1. repreſents that part of the fifth figure at D.... done by a larger magnifying-glaſs, *i. e.* by the third glaſs of Mr. *Wilſon*'s microſcope; A the arteries; B the veins of a frog's lungs, prepar'd as above-mention'd; C their inoſculations with each other; D..... the area of the microſcope, as it appears to the naked eye.

Fig. 2. part of the hinder foot of the young frog view'd when alive with the ſame microſcope; whereby the different magnitude of the extremities of the arteries and veins of the lungs in the firſt figure, and in this repreſented at CC, is very evident; the former being capable of admitting at leaſt three globules of blood to paſs a-breaſt; whereas, the extremities of the arteries and veins in the feet only admit of one globule of the blood to paſs before the other; A A the trunks of the arteries; B B thoſe

of

of the veins lying by the ſide of the toes; CC their extremities continu'd with each other, in the tranſparent membrane between the frog's toes; *a a* two of the frog's toes.

Fig. 3. and 4. repreſent the extremities of the arteries and veins of a frog's lungs, view'd with the fourth glaſs of the ſaid microſcope; A A the arteries; B B the veins; C C their conjunctions with each other D.... the area of the microſcope.

Fig. 5. repreſents one of the hexagonal area's of a frog's lungs, which were not ſo much diſtended by inflation, as thoſe parts of the lungs repreſented in the two former figures 3. and 4. whereby the little area's or cells in the interſtices of the extremities of the veins and arteries appear cloſer, and leſs than in the two forgoing figures, tho' view'd with the ſame microſcope; A the arteries; B the veins; D the area which is more magnified at Fig. 1.

Fig. 6. The lower part of one of the lobes of the lungs of a water-lizard, as it appears by the microſcope, when the blood is retain'd in the extremities of the veſſels, as in the preceeding figures; A A the trunk of the pulmonary artery; B B the vein; C C their branches joining with each other; D D the tranſparent ſmooth membrane, which in this animal is not veſiculated, or full of cells, as in the lungs of frogs, on which the blood-veſſels are expanded; nor does the internal ſurface of this membrane differ from the external, as in frogs and divers amphibious animals; the lungs of theſe water-lizards being veſicated and not veſiculated.

Remarkable Curioſities *in* Denmark *and* Holland; *by Dr.* Oliver. Phil. Tranſ. N° 285. p. 1400.

THE colleges and ſchools in *Copenhagen*, both as to their ſtructure and foundations are very ordinary; the beſt the Dr. ſaw there was the donation of the learned *Borrichius*; conſiſting of 12 apartments for as many ſtudents, which are conveniently provided with ſtoves for their manner of living in that cold country; there is in it a ſmall ſchool for public exerciſes, and a little library belonging to their college; the reſt of the ſtudents, excepting 100 maintain'd by the king in ſmall colleges, live at lodgings in the city, as at *Leyden* and other univerſities abroad; who, when the *Swedes* threaten'd them with a bombardment in the year 1700, form'd themſelves into a battallion, and did duty there, all the time the enemy was on the iſland of *Zealand*; there are in this univerſity, which

which was erected about 200 years ago, about 1000 ſtudents, and ſometimes they have had near 1500; the univerſity-library, is in one large room over one of their churches, and conſiſts of ſeveral libraries, the donation of particular perſons which are kept a-part, with the benefactors names over them in capital letters; the royal library belonging to the king, conſiſts of a great variety of books, in all languages, well condition'd and well choſen; the books of each country being plac'd by themſelves; the room is large and well built, and has a large gallery ſupported by pillars on each ſide; if *Gudius's* library at *Gluckſtadt* be added to this, as the Dr. was told it would, this library might be reckon'd amongſt the firſt rank of the *European* libraries; the king's chambers of rarities are in all eight, large and well built, over the royal library; they are furniſh'd with great variety of natural and artificial curioſities; the firſt contains coins and medals, both gold and ſilver, modern and antique, *Græcian*, *Roman*, *Daniſh* and *Oldenburgh*; beſides thoſe of other *European* nations kept ſeparate by themſelves, which altogether make a very valuable collection; amongſt the natural curioſities, which are in the other chambers, the moſt remarkable are,

1. The petrified child, which is the ſame that *Bartholine* makes mention of in his *Hiſt. Anatom.* of which alſo *Paræus*, *Licetus de Monſtris*, &c. give the hiſtory at large; this child was cut out of its mothers belly at *Sens* in *Champagne Anno* 1582, where it was ſuppos'd to have lain about 28 years; that it is a human *Fœtus*, and not artificial, is apparent to the eye; the upper part is of a gypſeous nature, not ſo hard as the lower, the thighs and buttocks being as hard and as perfect ſtone as can be, of a red colour, and of a grain and ſuperficies exactly reſembling ſuch ſtones as the Dr. has ſeen taken out of the bladder; he handled and felt it all over; it was firſt convey'd to *Paris*, and there it was bought by a goldſmith of *Venice*; of whom *Frederic* the III. king of *Denmark*, purchas'd it, and added it to his rarities. 2. Two elephants teeth, weighing 150 pounds a-piece. 3. Several heads of hares, with divers ſorts of horns, brought out of *Saxony*. 4. An egg ſaid to be laid by a woman, of the ordinary ſize of a pullet's egg; this, *Olaus Wormius* tells us, was ſent him by very good hands, and confirm'd by people of credit; and he further tells us, that the woman brought forth two eggs, with the uſual child-birth pains; the neighbours being call'd in to her aſſiſtance, they broke the firſt, and therein they found a yolk and

a white,

a white, as in that of a hen; the ſecond was preſerved and ſent to him; *Mus. Worm. p.* 312; *Jo. Rhod. Cent.* 3. *Obſ.* 57. 5. The horn of a ſea-unicorn, or *Monoceros*; ſo call'd becauſe it is ſuppos'd to have but one horn, tho' ſometimes more are found to grow out of the upper jaw; and the Dr. was credibly inform'd at *Copenhagen*, that one *Koens* a *Hamburger*, brought from *Greenland* the head of one of theſe with two horns thereon; the Dr. having carefully examin'd this horn (part of the head and upper jaw of the animal being brought home with it) he found it did not grow out of the middle, but from the left ſide of the upper jaw; ſo that it is probable there was a fellow to it, and then they may be ſaid more properly to be his teeth or tuſks, rather than his horns; whether this was only a *luſus naturæ* or not, or whether theſe animals naturally carry but one horn, as repreſented in the figures naturaliſts give us of them, the Dr. will not determine. 6. Several pieces of gold ore very rich, and ſome almoſt fine, dug out of the mines of *Norway* and *Hungary*. 7. Several large pieces of ſilver ore, likewiſe dug out of the mines of *Norway Anno* 1666; one of which weigh'd 560 pounds, was five foot ſix inches long, and four foot round, valu'd at 5000 crowns; from *Norway* there was alſo another piece, valued at 3272 crowns; Dr. *Oliver* obſerv'd a great many ſilver threads ſprouting out of theſe two pieces, and he ſuppos'd that the whole maſs had not above $\frac{1}{4}$ part of any baſer metal, mineral or earth mixt with it; there are ſeveral of theſe ſilver ramifications, all from *Norway*, which he took to be virgin-ſilver and pure metal. 8. A great variety of very large pieces of amber; ſome dug out of the iſland of *Anaker* near *Copenhagen*, and others found when they were opening the ditches for the fortifications of *Copenhagen*; ſome of theſe weigh about 40 or 50 ounces, and were found every where ſticking faſt to pieces of black timber like ebony; whether amber be of the vegetable or mineral kingdom, would require a great deal of time to diſcuſs; only that by the obſervations the Dr. made when he was in *Poland* and *Pruſſia*, where he ſaw great quantities every day fiſh'd out of the ſea, as alſo dug out of the earth, he is inclin'd to the former opinion; nor can he conceive, how thoſe animals that are found intomb'd in amber, being moſt of them, if not all inhabitants of the ſurface of the earth, ſhould be caught in it, were it only a liquid when in the bowels of the earth. 9. A numerous collection of very large branches of coral, white and red, and one black. 10. A large pair of

ſtag's

ſtag's horns growing out of a piece of wood, in a very ſurpriſing manner. 11. Another branch of a ſtag's horn, with a large piece of wood, naturally adhering to its top, which had pierc'd thro' the body of the wood, and grew ſome inches beyond it. 12. A ſheep with a horn growing about an inch long out of its ſide. 13. The Dr. meaſur'd the thigh-bone of a human body, that was three foot and three inches long; the head was two foot and five inches round, and the middle 19 inches and a half about. 14. Two very large ſcallop-ſhells, weighing 224 pounds each. 15. A piece of marble, with a natural repreſentation of a crucifix on its outſide, highly valu'd by the *Lutherans*; and M. *Hartman* ſhew'd Dr. *Oliver* at *Koningsberg* in *Pruſſia*, a piece of whitiſh amber, that with a variety of colours on the ſuperficies repreſented a woman with a child in her arms, which M. *Hartman* aſſur'd the Dr. was not artificial, and he kept it very religiouſly; there were beſides theſe, a great many more natural rarities: Amongſt artificial curioſities, Dr. *Oliver* obſerv'd;

1. A ſkeleton made of ivory in imitation of a human one, two foot and ſix inches long, ſo curiouſly and artificially put together, that one would take it for a natural ſkeleton. 2. Two crucifixes of ivory, with the whole hiſtory of our Saviour's paſſion, exceedingly well carv'd and expreſs'd; beſides he ſaw a great variety of toys made of ivory, curiouſly wrought on the outſide; as a ſmall man of war in ivory, with ſilver guns; ſeveral ſmall galleys and ſloops of the ſame materials, and one made of an unicorn's horn, with a gold anchor. 3. A watch made of ivory, with all its wheels and movements; ſeveral other utenſils made of ivory, and a unicorn's horn, curiouſly carv'd and turn'd; beſides ſome others of ebony, heart-oak, box, amber, ſilver, braſs, *&c.* which are kept together for the curioſity of the workmanſhip. 4. In another chamber there was nothing but the garments, arms and utenſils of *Indians*, *Turks*, *Greenlanders*, and other barbarous nations, in great number and variety. 5. A perſpective of the late king of *Denmark*'s family, the queen's face being in the middle, and eight princes and princeſſes round her, yet all conſpire to form the king's face, thro' a hole of a glaſs-tube. 6. Six golden ſepulchral urns, diſcover'd in the iſland of *Fuenen Anno* 1685 by a boor, as he was ploughing his land; when found, they were full of aſhes or a greyiſh ſoil; the largeſt is two ounces and a half, the other five, about two ounces and one drachm; this confirms the accounts given us

us by *Saxo-Grammaticus*, *Olaus Wormius* and others, that it was a very ancient cuſtom amongſt the northern nations to burn their dead, and then bury their collected aſhes in golden urns; they were very thin, and had three rings of gold round their necks, and ſeveral circles one within another, with one common center, carv'd on the outſide round the body of the urn; they held between four and five ounces of liquids. 7. Another ſepulchral urn of cryſtal, of a conical figure, found near *Bergen* in *Norway*, with a gold wire about it, weighing eight ounces. 8. The Dr. ſaw in another chamber ſeveral *Urnæ Lachrymales*, wherein were collected the tears of friends, which afterwards the old *Romans* mix'd with the aſhes of the dead; ſome of theſe were of glaſs, and others of earth, and of different ſizes; there were alſo braſs lamps of ſeveral magnitudes and various ſhapes; ſome of other metals, others of earth, in the ſhape of animals or idols that were worſhipped by the ancients; he alſo ſaw the *Stilus Æneus* of the *Romans*, the one extremity ſharp to write with, and the other blunt, to eraſe what was written. 9. The large *Daniſh* horn of pure gold, weighing 102 ounces and a half, is two foot and nine inches long, and holds about two quarts *Engliſh* meaſure; this horn was accidentally diſcover'd *Anno* 1639 by a country girl, in the dioceſe of *Ripen* in *Jutland*; it is no doubt, ſome *Runic* piece of great antiquity, by the figures carv'd on the outſide, which ſeem to be hieroglyphics, monſtrous ſhapes of devils, hobgoblins, *&c.* and perhaps, ſome of theſe might repreſent their gods; and probably this horn was us'd in their ſacrifices, as of old among the *Aſſyrians* and other ancient nations, who were wont upon ſolemn occaſions to entertain the crowd with a great noiſe of horns and trumpets; or rather to drink out of, at their ſolemn entertainments. 10. The *Oldenburg* horn of pure ſilver, gilt with gold, and variouſly enamell'd with green and purple colours, weighing about four pounds; the *Daniſh* antiquaries tell us ſtrange fabulous ſtories of this horn; which the Dr. omits, only obſerving, that whereas, amongſt other things they ſay, that this horn was given to earl *Otho* of *Oldenburg* *Anno* 989, by the workmanſhip, it is plain it cannot be of that date; for the figures and characters engrav'd and imboſs'd on its outſide are modern; which with the enamelling and other ornaments, all curiouſly done, make it a very fine, as well as valuable curioſity; the Dr. found in the ſame chamber a great many horns of this kind, ſome in metal, others of bullock's horns tipp'd

with gold about the edges, and ſome of ivory, and unicorn's horns, *&c.* all prettily wrought on the outſide with a great variety of emblematical fancies, according to the humours of thoſe countries and times they were made in; and they were ſo many cups to drink out of at their ſolemn entertainments; and this of *Oldenburg* was finer than the reſt, becauſe deſigned for the royal table; it is ſaid to have been made by command of *Chriſtian* the firſt, who liv'd in the 15th century, in honour of the three kings of *Cullein*.

Dr. *Oliver* went one day a-ſhore on the iſland of *Weenen*, which the *Engliſh* ſailors call *Scarlet Iſland*, from a tradition that queen *Elizabeth* had proffer'd for it as much ſcarlet cloth, as would cover it; this iſland is now an appendix to *Schonen* in *Sweden*, not above half a league from the main land; here the Dr. obſerv'd the ruins of *Tycho Brahe*'s caſtle, which he had built on this iſland, given him by king *Frederick*, who ſupplied him with money for the carrying it on in the year 1567; this caſtle was built in the middle of the iſland, but is now demoliſh'd, and quite eras'd to the ground; and all the vaults and under-ground works are fill'd up, excepting the large obſervatory, which *Gaſſendus* tells us, in the life of this noble *Dane*, was diſtinguiſhed from all the reſt of his apartments under-ground, that were very numerous, by a ſolid round ſtone wall, part of which is ſtill remaining; this was his great obſervatory, and was call'd by him *Stellæ-burgum*, or the city of the ſtars; as the caſtle was *Uraniburgum*, or the city of the heavens; the ſituation, no doubt was pleaſant, it being on a very ſmall eminence, in the middle of a plain iſland, not above three miles round; the ſame author tells us, that the king of *Denmark*'s liberality was ſo great towards this learned man, that the beſt workmen were employ'd about it, and every thing well contriv'd both for pleaſure and convenience, for inſtruments and aſtronomical obſervations, both above and under ground, beſides noble gardens, fiſh-ponds and a park; but by the fate of war between *Sweden* and *Denmark*, ſometimes the one and ſometimes the other being maſters of this iſland, there is not one ſtone left of this magnificent ſtructure; his inſtruments that were very fine, are now ſcatter'd up and down in *Germany*, and ſome few ſtill remain in *Copenhagen*; the Dr. ſaw there in the *Rown* tower his own celeſtial globe, which was ſix foot and $\frac{3}{4}$ in diameter: This tower was built in 1601, for making aſtronomical obſervations, near the royal college in *Copenhagen*, and is above 150 foot high, whoſe

whoſe area on the top is 60 foot diameter; the paſſage up to it is large enough for two coaches, and the aſcent ſo eaſy and hardly perceivable, that it ſerv'd for a place of parade for their gentry, when they had a mind to take the air in their coaches, riding up to the top, and ſo round the ring, as well as for an obſervatory; but M. *Romer* had converted the upper part of this tower to other uſes, where in a dark room he had his inſtruments for obſervation; here the Dr. ſaw his machine for obſerving the ſtars by day; there is a pole 8 or 10 foot long, erected perpendicular in the centre of an equinoctial plane, on the top of which pole there is faſtened a teleſcope, not much above three foot long, that reaches thro' the roof of the chamber, whoſe elevation is directed by an aſtronomical dial, upon the equinoctial plane, with an index fitted to it for that purpoſe, which determines it to the ſtar he has a mind to obſerve at any time; he is likewiſe ſaid to be the inventor of two other machines of great artifice and uſe; by the one he could ſhew at any time the ſtation of any planet, according to the *Copernican* hypotheſis; by the other he could demonſtrate all the eclipſes of the ſun or moon, both paſt or to come: There is, beſides all theſe, in the king's houſe in the garden at *Copenhagen*, a royal throne all of unicorn's horns, on which all the kings of *Denmark* are ſeated at their coronation.

In the year 1685, the Dr. was at *Koningsberg* in *Pruſſia*, where he ſaw the knife which was ſwallowed by a *Pruſſian* boor, who being ſick one morning, thruſt the haft of his knife down his throat, in order to make him diſcharge what offended his ſtomach; but forcing the knife too far, it ſlip'd down his gullet into his ſtomach, from whence it was extracted by an inciſion on the left ſide, a little below the ſhort ribs, with ſuch ſucceſs, that he lived ſeveral years after, in very good health; this happened in the year 1635; the operation was performed by Dr. *Daniel Swab*, and the knife is kept in a velvet bag in the King of *Pruſſia*'s library; and meaſuring it by an *Engliſh* foot-rule, he found it to be but 6 inches and about ½ long; the Dr. making an enquiry about it, was very well aſſured by ſeveral of the inhabitants that the matter of fact was true; and it is not likely, that the King of *Poland*, who was then at *Koningsberg*, the government of the city, and the college of phyſicians, who were conſulted upon the operation, and were all eye-witneſſes of it, would by printed certificates thereof contrive to impoſe a cheat upon the world; and one Mr. *Taylor*, a *Scotiſh* merchant in *Koningsberg*, told Dr. *Oliver*, that *Andrew Grunheide*, for that was the boor's name, was his particular friend and acquaintance;

that he ſaw his wounds ſeveral times, when the ſurgeons dreſſed him, and was godfather to one or two of his children after his recovery.

When the Dr. was laſt in *Amſterdam*, he went to a tavern, where the maſter was very curious in birds, and had a great variety of uncommon ones; amongſt which, he ſhewed him a cage with a bird in it, a little bigger than a capon, which he valued as a great rarity, and ſaid it coſt him near 100 *l.* ſterling; the Dr. owns he never ſaw a more beautiful animal in all his life, its body ſomewhat reſembled a hawk, but its head and neck were bald like a vultur, only it had a few ſhort feathers over its eyes, like eye-brows; its eyes were pretty large, and the iris was of a very fine bright pearl-colour; the feathers of this bird were curiouſly mix'd with a great variety of very beautiful colours; the bill and head were ſhaped more like the eagle than the vultur, tho' the Dr. took it to be of the latter kind, but of the ſmaller ſize; this bird was brought from *Carthagena* in *America*, and may be deſcribed thus; *Vultur Americanus minor Carthagenæ, corpore eleganti & plumis concinné admodum variegatis*; the Dr. preſumes that this bird can hardly be of the ſame kind with thoſe vultures *Monardes* tells us of, in the iſlands near *Lima* in *Peru*, that prey'd on the cattle in the fields, if not carefully watched by their keepers: The Dr. did not ſee the cherry-ſtone in the King of *Denmark*'s cabinet, which he was told, had ſome hundreds of heads engrav'd on the outſide thereof; but once in *Holland*, *Anno* 1687, he was ſhewn by an *Engliſh* gentleman, a cherry-ſtone of this kind with 124 heads on the outſide thereof, ſo that you might diſtinguiſh by the naked eye, popes, emperors, kings, and cardinals, by their crowns and mitres; it was bought in *Pruſſia*, where it was made, for 300 *l.* ſterling; whether this, or any other artificial curioſities of ivory, *&c.* before-mentioned, may compare with *Homer*'s nut-ſhell; or the ivory-ants, and other little animals ſaid to be made by *Callicrates*, whoſe parts were ſo very minute, that no body could ſee them, ſo as to diſtinguiſh the one from the other, but he who made them; or the ivory chariot made by *Mermecides*, which a fly covered with its wing, and a ſhip of the ſame hid under a bee's wing; and if, what *Pliny* and *Solinus* tells us, be true, whether the ancients have not out-done us in ſuch kind of curioſities? The Dr. leaves it to others to determine.

A young Girl born Deaf *and* Dumb, *taught to ſpeak, with other Obſervations; by Mr.* Charles Ellis. Phil. Tranſ. N° 286. p. 1415.

MR. *Ellis* having viſited *Van Dalen* at *Haerlem*, he ſhew'd him, beſides his own daughter, a young girl, born deaf and dumb, yet taught by Dr. *Amman* to ſpeak very intelligibly; he heard her read *Dutch* and *Latin*; ſhe was about ſeven years old.

Here Mr. *Ellis* was deſirous to ſee the 1ſt book printed by *Coſterus*; but he found it was not *Donatus*, as the *Inſcriptiones Hollandicæ* ſay, nor *Virgil* or *Tully*'s offices, as others have acquainted the world; but a *Dutch* piece of theology, printed only on one ſide of the paper; and after this is a ſingle page of *Latin*, entitl'd *Liber Vitæ Alexandri Magni*, which made ſome take it to be *Q. Curtius*; but it is a monkiſh *Latin* of that time; this, and the theology, were printed in the year 1430; whereas the inſcriptions, and ſome authors have told us from *Coſterus*'s picture, that printing was not invented by him till the year 1440; but a picture of *Coſterus* before another *Dutch* piece, bound up in the ſame volume, and printed 1432, bears the date of 1430, under which picture is the inſcription mentioned by Mr. *Ray* (only the date is ten years ſooner) and the tetraſtic, which was tranſcribed by the author of the inſcriptions from an effigies of *Coſterus*, which was then extant in a garden of this place, but it is not now to be found.

Mr. *Ellis* ſaw at *Amſterdam* a moſt curious phyſic-garden, admirably furniſhed, and in excellent order; which, as containing more ground, and having more foreign plants, far exceeds that at *Leyden*. Here he alſo ſaw two female children, joined together from the neck to the navel; the *Viſcera* in both were double and perfect, the head only was ſingle, but common to both, and look'd over the right ſhoulder of one, and the left of the other.

At *Maeſtricht*, Mr. *Ellis* went into the quarry, which is larger than it has been deſcribed in one of the Tranſactions, being three hours in length, and one in breadth, and can ſhelter 100000 men; it coſt Mr. *Ellis* a fit of an ague, thro' its exceſſive chillneſs; the ſtone dug out of this quarry, is much like our *Kettering*; and the Jeſuits have here a very fine chapel built of it.

Franciſcus Linus's dials at *Liege*, the original of thoſe formerly in our *Privy-Garden* at *London*, are much decayed, there remain-

remaining none of any uſe, but that which diſtinguiſhes the hour by feeling, and the globe which ſhews it in all other parts of the world.

At *Namur* there are no curioſities, but ſuch as are military, excepting only the *Cachot* cut in the rock of the caſtle, with apartments for 600 men, and all rooms of conveniency, as kitchens, *&c.* which was done by the order of Marſhal *Bouffiers*, to defend the garriſon from the bombs; and was the labour of four years: At *Liege* is Sir *John Mandevil*'s tomb, whoſe epitaph is alſo at St. *Albans*, which may be difficult to be reconciled.

At *Bruſſels*, Mr. *Ellis* ſaw a young *Friezland* boy, of about five years of age, round the pupil of whoſe eye, they pretend, that there is naturally engraven *Deus meus*, and the ſame in *Hebrew*; this is look'd upon as a prodigious miracle in thoſe parts; but, upon nicely ſurveying it, he could perceive, that it was only the iris of the eye, not join'd circularly, but laſh'd out into *Fimbriæ*, which here and there might be thought to form ſome imaginary letters; as beginning at the lachrymal corner of the left eye, there is ſomething reſembling D, I, and U, but not a veſtige for the ſtrongeſt fancy to work out any more; nor any letter of *Hebrew* in the right eye, as they pretended; Mr. *Ellis* does not doubt, but as the boy grows up, the others may conjoin again.

There are very few natural curioſities at the *Hague*; but there is an unparallel'd piece of art, which is performed by one *Elizabeth Pyberg*, who cuts in paper not only towns, as *Leo* and *Honuſſerdyke*, but alſo faces of an exceeding likeneſs; ſhe did King *William* and Queen *Mary* better than any limner, and ſhe refuſed 1000 gilders for the pieces; and Mr. *Ellis* could not think, but the Queen's drapery was point, (it was ſo very curious) till he had very carefully examined it.

Animalcula *in Water, the Solution of* Silver, *&c. by M.* Leewenhoeck. Phil. Tranſ. N° 386. p. 1430.

ABOUT the latter end of *July*, M. *Leewenhoeck* obſerving ſomething that ſhone in the water, which gently flows by a canal thro' *Delft*, and which is very clear, and almoſt of the colour of the *Maeſe* water; he took a glaſs-tube of almoſt a foot length, and a finger's breadth, which he filled with this water, and viewing it with a microſcope, he obſerved ſeveral ſorts of *Animalcula* ſwimming therein, ſome of which he had never before met with; he viewed this water ſeveral times in one day, but he could not diſcover the ſhining matter which he had ſeen in

in the canal; on the 4th of *Auguſt* he renewed his obſervations, and then he could ſee in eight or ten places ſeveral ſmall particles ſticking ſo faſt to the ſides of the tube, that tho' he put the ſaid water into a gentle motion, he could not remove them; whereupon, viewing the ſame with his microſcope, he could plainly ſee thoſe particles, repreſenting a large bough, or branch of a tree, with a great number of ſprigs about it; moſt of theſe branches were faſtened with their ſtems to the ſides of the tube, and ſeemed to ariſe out of a very ſmall particle of matter that was faſtened in like manner; that he might be further ſatisfied herein, M. *Leewenhoeck* took another tube, that was longer and broader than the firſt, and filled it with the ſame water, having firſt rinſed the tube once or twice; he viewed this water alſo ſeveral times, after it had ſtood 30 hours in the tube, and he again diſcovered the ſame ſort of boughs, as complete and perfect as if you were to ſee the ſame with the naked eye on a tree; and amongſt others, he obſerved one in ſuch a poſition, as if the thick branches from whence the reſt proceeded, lay juſt againſt his eye; he placed a microſcope before this laſt particle, with a deſign to obſerve from time to time, whether it would increaſe in bigneſs; after the ſpace of ſix hours, he could not find that it was grown any bigger; and he obſerved, that the extremities of the twigs, which were about 20, were laden with little tranſparent bubbles, whoſe diameters were twice as big as the ſaid extremities; having now likewiſe obſerved about the twigs, a ſort of tranſparent *Animalcula* of the ſame ſize with thoſe bubbles; M. *Leewenhoeck* ſuppoſed, that the above-mentioned round bubbles were the ſame with thoſe *Animalcula* that had taken their ſtation on the extreme parts of the twigs; and he was confirmed in that opinion, by perceiving the next day in the morning, after that the water had been 48 hours in the glaſs-tube, that moſt of theſe round bubbles were got off the twigs, and that a very few of the *Animalcula* were upon them, and there remained immoveable, whilſt he made his obſervations; 12 hours after this, he could not ſee that the aforeſaid branches were grown larger; but he then obſerved, that ſeveral of the ſmall twigs were again inveſted with round bubbles, and an *Animalculum* that was about 50 times as big as one of the bubbles, was running upon one of the branches; and foraſmuch, as the extremity of one of the twigs, where that *Animalculum* had been, was again laden with the ſaid bubbles, he concluded, tho' he had no ocular proof thereof, that the ſaid *Animalculum* had dropp'd her young ones there.

On

On the 6th of *Auguſt*, he took another glaſs-tube of above a foot long, and an inch in diameter; one extremity of which was ſealed hermetically, that there might be no cauſe of ſuſpicion, that theſe branches or twigs proceeded from the cork; and having rinſed the tube two or three times, he ſet it on his deſk, and viewed it ſeveral times, but he could perceive no branches, till after the water had ſtood above 40 hours in the tube; after which he took a microſcope, and faſtened it to the tube, to ſee whether the branches grew any larger, after the firſt diſcovery of them, but as nicely as he viewed them, he could perceive no alteration; now, he could ſee on the extreme parts of the ſaid twigs three or four, or ſometimes five round bubbles like roſes, by one another; and when one of theſe branches (which was only faſtened to the glaſs by its thickeſt extremity) came to be removed by that ſmall motion, into which he put the water; all the five ſmall twigs were likewiſe put into motion, and the ſame motion was alſo imparted to the bubbles, tho' ſome of their ſtalks were ſo exceeding minute, that he could not ſee how they were joined to the ſaid twigs; he poured out the water very gently from the glaſs-tube, with an intention that the branches, which were faſtened by their ſtems only to the ſides of the glaſs (whilſt their twigs were kept in a continual motion by the water) might lie along on the glaſs, in order to have them the better repreſented.

Plate VII. Fig. 7. A B C D E F ſhews the ſaid particle, as it lies on the ſide of the tube; A the ſtem or root of the ſaid branch, whereby it was faſtened to the ſides of the tube; here you may ſee what a vaſt number of branches and twigs there are in this ſingle figure, which, indeed, appears irregular upon the paper; whereas, in the water, where they were unravell'd, and could play free, it was a very agreeable ſight, being in colour like oak, and beſet in ſeveral places with round bubbles, juſt as if they were compoſed of ſuch particles; G and D repreſent ſome of the particles of the ſhape of a roſe, which ſeem to conſiſt of round bubbles, as alſo H, tho' their ſtalks were ſo fine, that he could not perceive them to be united to the main branch; however, when that moved, they moved alſo; as ſoon as the water was poured out of the glaſs-tube, he immediately viewed the ſaid branch; and between two of the ſprigs B D and B E, he ſaw two of the *Animalcula* ſwimming in the little water which remained unexhaled amongſt the twigs, and their ſhape was like that of the bubbles repreſented by H; during his obſervations, he diſcovered an exceeding ſmall particle, breaking off from one

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of the particles or bubbles under the ſaid letter H, and preſently it ſwam off with a little motion, but the whole ſpace of its progreſs was not above a hair's breadth; the ſaid ſmall particle was certainly an *Animalculum*, for he could plainly ſee it turn and wind itſelf about; he alſo obſerved a little motion in another of theſe particles or bubbles, which reſembled a roſe, but it ſtill remained entire; on the ſides of the ſame tube, there lay ſeveral other ſmall branches, but not ſo perfect as thoſe repreſented in the 7th Fig. and when the water was poured out, they appeared like Fig. 8. IKL, and Fig. 9. MNO: It cannot be ſuppoſed that theſe boughs, or little trees, proceed from a ſeminal matter in the water, but rather, that they are compoſed of that matter, which ranging in ſmall particles thro' the water, does by a kind of natural inclination unite, or coagulate, into one body; and this will not ſeem ſurpriſing to any perſon, who has ſeen the like experiment in filing of iron; for if you apply that part of the iron which you file, and which ſtill remains warm, to the filings, it will immediately attract them, and they will hang down like a chain from the iron; nay, if you apply a magnet to theſe filings, the attraction will be much ſtronger.

M. *Leewenhoeck* did ſeveral times diſſolve ſilver in *Aqua-fortis*, and as ſoon as he put it into the *Menſtruum*, he always found a great number of air-bubbles ariſing from the ſilver, which before their ſeparation from the metal, were as big as a common pin's head, or a grain of ſand; theſe air-bubbles, as ſoon as they were ſeparated from the ſilver, and in proportion as they mounted towards the ſuperficies of the water, became ſmaller and ſmaller, inſomuch that they almoſt eſcaped the naked eye, and preſently after they vaniſhed entirely; and this change happened, uſually in the ſpace of three pulſations; ſome of theſe air-bubbles laſted a little longer; others again, tho' as big as a pin's head, burſt in pieces before M. *Leewenhoeck*'s eyes, without leaving any other ſmaller bubbles behind them; for his further ſatisfaction in this matter, he prepared a glaſs-bottle, whoſe axis was an inch and a half thick, of the ſhape delineated by Fig. 10. ABCDEFG; whereof ABCD repreſents the greater bowl or globe, and ADEG the ſmaller, and F the bore or orifice of the glaſs; M. *Leewenhoeck* placed this glaſs ſloping, having firſt filled it, a little above EG, with *Aqua-fortis*, whilſt it ſtood perpendicularly; and then he put into it two grains of fine ſilver, which lay at the bottom of the glaſs, in ſuch proportion as is expreſſed in the ſaid Fig. at B, whereby all the bubbles proceeding from the ſilver muſt aſcend perpendicularly to C; being perſuaded,

that when the quantity of air that was extracted from the ſilver would arrive at C, it would remain there; and that in proportion to the ſpace the ſaid bubbles poſſeſſed, ſo much of the *Aqua-fortis* would be protruded from the larger bowl to the ſmaller one; now, when he ſaw that but very few more bubbles aroſe from the ſilver, he could very plainly perceive, that moſt of thoſe air-bubbles that had been extracted, did not only become leſs before they arrived at C, but were quite vaniſhed; now that the ſilver was viſibly united to the *Aqua-fortis*, and had remained ſo for 24 hours, there was as much air in the glaſs at C, as would fill the ſpace of three or four pins heads; whereas, there aroſe ſuch a vaſt number of air-bubbles from the ſilver during its ſolution, that M. *Leewenhoeck* was ſurprized what became of them, ſeeing they were in a manner vaniſhed, without leaving any traces behind them; he made the air in C to diſlodge by the orifice F, by raiſing the glaſs perpendicularly; and then upon throwing three times as much ſilver, a vaſt number of air-bubbles continually aſcended towards C, but they were diſſipated before they could arrive at the top; and ſuch of them as were larger, and held out till they came to C, did then burſt in pieces, without leaving any veſtige behind them, excepting always as much air as would fill the ſpace of three or four pins heads; further, he put 30 grains of ſilver into the ſaid water, without obſerving any other remarkable difference, only that there remained at C, as much air in quantity as an ordinary pea.

In theſe his obſervations, M. *Leewenhoeck* did likewiſe take notice, that the larger the air-bubbles are, which ariſe from the ſilver, the faſter they mount towards the top of the glaſs; and this alſo takes place, M. *Leewenhoeck* ſuppoſes, in what the learned call *Aer ſubtilis*; viz. how much the larger the particles of air be that perſpire from our bodies, the faſter they aſcend; and ſo likewiſe in the deſcent of all heavy bodies towards the earth; as for inſtance, take two iron balls, one an inch in diameter, and the other five inches, and let theſe two iron balls fall at the ſame time from the ſame height; M. *Leewenhoeck*'s poſition is, that that ball, whoſe axis is five inches, muſt cut thro' a column of air 25 times greater than that thro' which the one inch ball paſſes; this being granted, he then ſays, that as thoſe two columns of air, thro' which the iron balls muſt paſs, are as 1 to 25; ſo the gravitation of both the ſaid balls is as 1 to 125; now, that ball, which being 125 times heavier, and paſſes thro' a column of air that is but 25 times bigger than the other, muſt needs, he ſays, move quicker in its deſcent than the ſmaller ball; ſo conſequently, muſt thoſe particles (ſuppoſing them to be

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compoſed of the ſame matter) that are largeſt, perſpire firſt and ſooneſt thro' our bodies.

But to return; having firſt weaken'd ſome of this *Aqua-fortis*, thus impregnated with the ſilver, he put a little of it into a clean glaſs-tube, and now and then he threw into it a little copper of the bigneſs of a grain of ſand; and then viewing the ſilver-water with a microſcope, he obſerved that the ſilver in this clear water was coagulated into ſuch bodies, as are repreſented by the above-mentioned trees, which coagulation we may call an inclination; and to give a better idea of this coagulation, there is repreſented a ſmall particle of the ſilver, no bigger than a large grain of ſand, in Fig. 11. PQRST; M. *Leewenhoeck* was ſurpriſed to ſee, in a few ſeconds of time, ſuch a coagulation of branched particles (which were inviſible even thro' a good microſcope) ariſing from a ſeeming clear, diaphanous, and liquid matter; now, what ſhould occaſion ſuch a coagulation, inſomuch, that no ſilver ſhall remain in the water, was to him entirely inexplicable: From theſe ſmall coagulated ſilver particles, M. *Leewenhoeck* was led to conſider the rich ſilver ſtone brought in ſmall fragments from the *Weſt-Indies*; whoſe particles are coagulated in juſt ſuch branches as appeared by his microſcope in the above-mentioned water; from whence, he was more fully confirmed in his hypotheſis, that when the parts of that ſtone were a fluid ſubſtance, the ſilver particles were alſo mix'd therewith; and when the ſtone came to conſolidate, the ſilver alſo coagulated in branches; juſt as we ſee it now lying in the ſtone, wherewith it is ſurrounded, and, as it were, impriſoned; from whence ſeveral have imagined, that in proceſs of time the ſilver grew in the ſaid ſtone.

M. *Leewenhoeck* took a piece of gold, and throwing it into a proportionable quantity of *Aqua regia*; in its ſolution he ſaw air-bubbles aſcending in like manner, as in the ſilver; a little time after, he took ſome of the *Aqua regia* thus impregnated, and laid it on a clean glaſs, to obſerve, after the mingled ſalts were coagulated, what gold particles he could diſcover therein; when it was fair warm weather, the ſalts were for the moſt part coagulated, but in ſuch a variety of figures, that they were hardly to be accounted for; ſometimes repreſenting an exact hexangular figure, and by and by the very ſame figures were no leſs irregular; the occaſion of which was, as M. *Leewenhoeck* ſuppoſes, becauſe, the coaleſcence of new particles was not equal on every ſide; but that which was the moſt remarkable was, that upon theſe ſalt particles, that were as tranſparent as yellow cryſtal, there lay other ſalt particles of a fine gold colour,

and ſometimes they appeared to him, as if theſe fine gold colour'd ſalts were incloſed in the other ſalt particles; but when the weather grew damp and moiſt, all the cryſtal ſalts were diſſolved, and the gold coloured ſalts were mix'd with the common particles; M. *Leewenhoeck* took another little piece of gold, that had been wrought by a goldſmith, and having beaten it very thin, he put it into the ſame glaſs, where the other gold was with the *Aqua regia*; and he obſerved, that a white ſubſtance was ſeparated therefrom and ſubſided to the bottom of the glaſs; for as *Aqua-fortis* diſſolves ſilver, whilſt gold eſcapes untouched, ſo *Aqua regia* diſſolves gold, without affecting ſilver at all; from hence he infer'd, that that gold was alloyed with ſome ſilver, which was the white ſubſtance ſeparated, as he ſaid before; the piece of gold, that lay in the *Aqua regia*, would not unite therewith; whence he concluded, that there was too much gold and too little water, for he had made the glaſs ſo hot, that he could not handle it: Moreover, he took a ſmall piece of copper, and putting it into *Aqua regia*, where a little gold had been already diſſolved, he preſently obſerved that the *Aqua regia* began to operate upon the copper, as if it had lain in *Aqua-fortis*; the gold alſo united with the copper, but in much ſmaller branches than ſilver in *Aqua-fortis*; and he ſaw, that the gold coagulated ſo ſtrongly with the copper, that the water about the ſaid copper was quite diveſted of its gold colour; and after an hour's time, the water was ſo impregnated with the particles of the copper, that it aſſumed a green colour, and then the gold that lay about the copper might be perceived by the naked eye.

Again, M. *Leewenhoeck* took other *Aqua regia*, that was impregnated with ſo much gold, that it could diſſolve no more; and he obſerved, that the coagulated ſalt particles were of an exceeding fine gold colour, being compoſed of extremely ſmall particles, and the corners or angles were very regular; he plac'd thoſe ſalts before his microſcope, and they appeared of ſuch a figure and texture, as if it had been a piece of gold newly taken out of the mines; now, in order to expoſe to view the coagulated ſalt particles in their firſt coalition, he put the ſaid impregnated water on a clean glaſs, and then cauſed part thereof to run off the glaſs again, that the remainder might lie as thin as poſſible in the glaſs without touching it; M. *Leewenhoeck* ſuppoſing, that by the ſaid water lying thus thin, the ſalt particles might coagulate the more regularly; he obſerved afterwards, that moſt of thoſe ſalt particles were hexangular, tho' ſo exceeding minute, that they almoſt eſcaped the naked eye; and ſeveral of them were

regular

regular hexagons, as repreſented in Fig. 12. A, B, C; Fig. 13. D, E, F; Fig. 14. G, H, I; Fig. 15. K, L, M; and Fig. 16. N, O, P; moſt of theſe figures were as tranſparent as glaſs, and all of them were ſurrounded with a liquid matter, (ſomewhat of a gold colour) that did not exhale, tho' the weather was very warm and dry; moreover, he ſaw a vaſt number of particles ſo exceeding ſmall, that their ſhape was not diſtinguiſhable, tho' he likewiſe took them for ſalt particles; the rather, becauſe he could not obſerve any of theſe ſmall ſalts lying near the aforeſaid large ones, which, thro' the ſympathetical inclination of homogeneous bodies, he concluded to be compoſed of a congeries of ſuch ſmall ones: He alſo ſaw other particles that were not pellucid at all, which he ſuppoſed were ſurrounded with ſo many gold particles, that they were not only of an irregular figure, but were alſo opake; ſeveral of theſe ſalt figures were more protuberant in the circumference than in the middle, and had alſo ſeveral rings, which confirmed M. *Leewenhoeck* ſtill the more in his opinion, of the ſecret inclinations of homogeneous bodies; and thus in their increaſe, they preſerve the ſame ſhape, which the ſingle ſalts had put on at their firſt coagulation: M. *Leewenhoeck* alſo put a little piece of copper into ſuch water, and he obſerved, that immediately the gold had united itſelf partly with the copper, but the *Aqua regia* had not ſo much power over the copper, as to protrude out of its ſubſtance ſo many air-bubbles, as it might otherwiſe have done, had there not been ſo much gold therein; the water thereupon aſſum'd a greeniſh colour, and all the yellow colour was turned into coagulated gold, inſomuch, that the gold might be diſtinguiſhed from the copper by the naked eye; particularly, the extreme parts of the little boughs, which were formed by the coagulated gold; tho' the ſaid gold conſiſted of particles ſo very minute, that they did not appear larger to a good microſcope, than the ſmalleſt grains of ſand do to the naked eye.

When M. *Leewenhoeck* had weakened with rain-water the *Aqua regia*, which had been impregnated with a great deal of gold; and had then put into it a bit of copper he obſerved, that in a ſhort time the gold was coagulated or united with the copper, and that the water was turned to a light green: He alſo obſerved, that the ſmall twigs of theſe coagulated particles were not of a pure gold colour; from whence he infer'd, that there was copper blended therewith; the ſaid *Aqua regia*, which had been impregnated with gold, having remained ſome days in the glaſs, he perceived, that where it was thickeſt, it was covered with a film

film or ſkin; and that moſt of the ſalts, when the weather was not warm, nor the ſun ſhined, were diſſolved, and much more in rainy weather: Moreover, M. *Leewenhoeck* expoſed the glaſs with the ſaid water to ſuch a degree of the heat of the fire, that the ſalts evaporated in ſmoke, and that part of the glaſs where there lay leaſt of the *Aqua regia*, aſſumed a colour that was ſomewhat upon the red; but where the ſaid water lay thicker, he could not ſee the fine ſhining gold with the naked eye; but upon raiſing that glaſs, where the gold lay, higher to the light than the microſcope, he ſaw that the gold particles were not united with the other, but now and then coagulated into branches; and where the gold particles were not thus coagulated, they were ſo very ſmall, that how nicely ſoever he viewed them, they eſcaped his ſight; and tho' there lay together more than 1,000,000,000 of theſe ſmall particles, all of them did not make a body that was bigger than a ſingle grain of large ſand; where this matter lay thin and diſperſed, he obſerved that its ſmall particles were ſuch ſolid and compact bodies, as did not admit the leaſt ray of light; and where they lay ſingle, he ſaw other particles ſtill ſmaller, whoſe bodies were more looſe, but M. *Leewenhoeck* ſuppoſed that theſe laſt were ſome particles of that matter, which the *Aqua regia* had left behind it: Now, after that the ſaid *Aqua regia* had remained on ſome of the glaſſes ſeveral days, and the ſalt particles for the moſt part were changed into a fluid ſubſtance; he obſerved amongſt ſeveral of the coagulated branches ſmall diſtinct particles, which he ſuppoſed to be gold, tho' by reaſon of their minuteneſs, he could not perceive their colour; to ſatisfy himſelf herein, he took a ſmall glaſs-bubble, with as much *Aqua regia* impregnated with gold, as was ſomething bigger than a large pin's head; and he ſet it over ſuch a ſtrong fire, that both the glaſs and gold were ready to melt; and then viewing the glaſs, he ſaw very plainly, that a ſmall portion of the ſaid gold was coagulated into branches, and that theſe coagulated particles were round knobs or bubbles, which were diſperſed in great numbers over the whole glaſs; in ſome places cloſe together, in others thinner, of different ſizes, and ſeveral of them ſo ſmall, that tho' he viewed them thro' a good microſcope, they in a manner eſcaped his obſervation; inſomuch, that it is almoſt impoſſible to conceive, unleſs one has had ocular demonſtration thereof, that ſuch vaſt numbers of gold globules could proceed from ſo ſmall a quantity of matter; and who knows how many more gold particles muſt coaleſce in melting, to compoſe one of theſe minuteſt globules; now, tho' the ſmall gold particles could

not

not be diſcover'd, when ſurrounded with *Aqua regia*, yet the ſhining gold colour of them all could be eaſily ſeen (excepting only the very minute globules) appearing like ſo many complete round pellets.

In winter, when thoſe ditches, in which M. *Leewenhoeck* had ſeen a deal of that green weed, called duck-weed were cover'd with ice, he ſaw but very little of it, and what he ſaw had a very ſmall leaf; upon this, he thought it might be poſſible for thoſe green weeds to ſpring from the earth in warm weather, tho' it did not ſeed upon the ground, nor increaſe in bigneſs there; for ſuppoſing, as it really happens, that theſe weeds in warm weather, by the rarefaction of the particles of air in their veſſels are driven up to the ſurface of the water, the ſame weeds by the contraction of the air in cold weather will become heavier than the water, and conſequently ſink to the bottom; and according to the change of the weather, have their viciſſitudes of emerging or ſubſiding: To be convinced of this riſing and falling of the green weeds, take a ſmall glaſs-bubble, ſuch as that repreſented by Fig. 17. QRST, leaving the ſmall orifice at T open for the water to run in and out at, and let this bubble be put into a veſſel with water; and you ſhall find, that by the dilatation of the particles of air within the ſaid bubble in ſummer, it will riſe to the ſurface of the water; whereas the ſame air, thro' its elaſticity, being contracted in cold weather, will make room for the admiſſion of a maſs of water ſo much heavier than itſelf into the ſaid bubble, and then it will ſubſide.

The Seeds *of* Oranges, *&c. by the Same.* Phil. Tranſ. N° 287. p. 1461.

M. *Leewenhoeck* had ſeveral times open'd the kernels of oranges and lemons; and he often found that what we call a ſtone, kernel or ſeed, is improperly ſo call'd; and that after ſtripping it of the ſkin or membrane, we ſhall frequently find that two ſeeds are inclos'd therein; to wit under the ſkin, and without ſide of the kernel there is a ſmall ſeed, ſuch as had not occur'd to him in other ſorts of ſeed; it is true, that you ſhall often find in hazel-nuts, almonds, peach and apricock-kernels, a double ſeed, but then each of them is inclos'd in a ſeparate membrane, having no communication with each other, but by a bare contact; whilſt each has a diſtinct ſtalk or ſtring, by which conſequently they receive their proper nouriſhment.

In

In *November*, M. *Leewenhoeck* had a preſent made him of *Surinam* oranges; in the firſt he open'd he found 38 complete kernels, but in neither of two others could he meet with four good ſeeds; he open'd ſeveral kernels of the firſt orange, one of which, inclos'd in its membrane, is repreſented by A B C D Plate VII. Fig. 18. after ſtripping one of theſe kernels of the outer membrane, he diſcover'd that there lay a ſtring under it, that caus'd a little protuberance in the firſt ſkin repreſented in the ſaid Fig. by A B C; from which ſtring, not only the ſeed, but alſo the plant within it receiv'd its increaſe and nouriſhment; E F Fig. 19. ſhews the ſame ſeed ſeparated from its firſt and hard membrane, which is only deſign'd, as M. *Leewenhoeck* ſuppoſes, for the defence of the inward parts; whereas, nuts, almonds, peach-ſtones, *&c.* are arm'd with ſtrong thick ſhells; F G repreſents the aforeſaid ſtring, which he ſeparated a little from the ſeed itſelf, to render it the more viſible; and it is not only join'd to the ſeed at F, but extends its ſmall veſſels alſo thro' the ſecond membrane from F towards E the ſeat of the plant, thence to receive its nouriſhment; but thoſe veſſels are ſo exceeding fine and minute, that you loſe ſight of them before you can trace them to their origin; now we may certainly conclude, that the ſaid ſtring does actually comprehend in itſelf as many diſtinct veſſels, as are to be found in the orange-tree when arriv'd at its full maturity; for if all theſe veſſels were not in the young plant, whilſt it lies involv'd in its mother's, *viz.* the kernel's *Matrix*, whence could they afterwards proceed? M. *Leewenhoeck* ſucceeded ſeveral times, but not without a great deal of trouble, in diſcovering the veſſels within the ſaid ſtring; Fig. 20. H I K L M N repreſents a part of the ſame ſtring cut a-croſs, which Fig. 19. F G ſhews entire, and in its whole length; the ſaid particle of the ſtring at H I M N has abundance of exceeding ſmall veſſels, but very hard to be ſeen; about I K L M they grow larger, and conſequently are more viſible; and thus you may ſee a great many, tho' not all the veſſels; after he had made this obſervation, he bethought himſelf, whether theſe great veſſels were not the origin of the contexture of that membrane, which covers the ſeed; and on the other ſide, whether the former repreſented by H I M N did not feed the ſeed and plant.

Fig. 21. O P Q repreſents a piece of another ſtring of an orange kernel cut a-croſs plac'd before another microſcope; R S T V that part of the hard membrane that ſurrounds it; T V Q W

VQW faintly ſhews, that vaſt number of fibres, particularly at QW, which nature uſes in the contexture of ſuch a ſmall ſtring, which made M. *Leewenhoeck* ſuppoſe, that thoſe long fibres repreſented by QW were deſign'd to add a ſtiffneſs and ſolidity to the outward membrane, for the better defence of the internal veſſels; he often obſerv'd, that the outmoſt membrane RSTV did compreſs the ſtring ſo cloſely, that there remain'd but little ſpace between them; in the ſame Fig. XYZ repreſents that membrane, which ſurrounds the kernel or ſeed and the plant; and all the membranes are very thin, particularly the innermoſt of them; upon cutting ſuch a ſeed or kernel a-croſs, one would take the particles of which it is compos'd, to be nothing but irregular globules ſqueez'd or compreſs'd cloſe together.

Fig. 22. AB repreſents ſuch a ſeed diveſted of its membranes, and which ſeem'd to have but one plant within it; whereas, he has often ſeen under the membranes another ſmall plant, which lay as if it was ſqueez'd into the ſubſtance of the ſeed, and ſo is not to be ſeen till the ſeed is ſtripp'd of its membranes, contrary to what M. *Leewenhoeck* has before hinted, concerning nuts, peaches, almonds, *&c.* which, where there is a double ſeed, lie entire and diſtinct in their proper membranes; he has likewiſe obſerv'd under the membrane of an orange-kernel three diſtinct ſeeds with their plants, whereof ſome indeed, were larger than the others; theſe ſeeds with their inclos'd plants are eaſily divided into two lobes or diſtinct parts, inſomuch that they do not ſeem to have been united, but only where the ſmall plant lies; ſo that the whole kernel AB was fram'd by nature for no other uſe, as he ſuppoſes, but to nouriſh the tender plant within, till it is able to ſtand alone, and draw its ſubſiſtence from the earth about it; having ſplit the ſeed AB into two parts, one of which is repreſented by Fig. 23. CDEF, together with part of the plant, which would have become a tree ſticking cloſe to it, you may ſee the plant itſelf at C, no bigger than a grain of ſand to the naked eye; the counterpart of the aforeſaid kernel is repreſented by Fig. 24. GHIK, and G the little pit or bed of the plant; and in the ſaid figure between H and K the concavity wherein the ſecond ſeed alſo lay, as likewiſe between D and F Fig. 23: This ſight was wholly new to M. *Leewenhoeck*, tho' he had diſſected ſeveral ſorts of ſeed before; *viz.* to ſee in the middle of one ſeed or kernel another complete and perfect ſeed; eſpecially when he conſider'd that from the veſſels, ariſing from

the ſtring, and diſperſing themſelves thro' the membrane both the kernel and plant are produced; and yet the ſap veſſels muſt inſinuate themſelves into the very heart of the ſeed, before they can produce a ſecond lodged within it; plac ing ſuch a ſmall plant as is repreſented by C in Fig. 23. before microſcope, he had it delineated, as may be ſeen in Plate VI Fig. 1. LMNOPQ; whereof QLM is partly that whic nature intends for the body and root of the tree; NOP t leaves, wherewith the young plant is already provided; an OP is that part of the leaf, which is next the ſight, and ſome what protuberant, by reaſon of the ſmaller inclos'd leaves; M and P Q ſhew the two ſides of the plant torn off from the ker nel, to which it was united, and from which it received nouriſhment; moreover, he turned the ſaid young plant a litt about, as it ſtood before the microſcope, in order to repreſe the two largeſt leaves; whereas, in the former poſition he cou ſee but one of them.

Fig. 2. STV repreſents the ſaid two large leaves; betwee which, according to all appearance, a great many ſmall one are ſhut up; and when he came to cut the leaves a-croſs, they lay involv'd in the bed of the plant, he imagin'd that h ſaw the ſaid ſmall leaves; and in cutting, after the ſame man ner that part of the plant which is to be the body and roo of the tree, he diſcover'd within the ſmall particle, th which was deſign'd for the pith, and even the wood itſelf, an all as plainly, as if he had been viewing with his naked eye young plant of an inch thick.

Fig. 3. WXYZ repreſents the texture of the pith, as appear'd to him; wherein you may obſerve a great many ſma particles, which at firſt ſight, one would be apt to take fo irregular globules, but placed in a right line, and all of the of a greater length than breadth; theſe M. *Leewenhoeck* too to be nothing elſe but ſmall tubes or veſſels, whereby th plant receives its nouriſhment, and perhaps, every one them is cover'd with a diſtinct membrane; the parts whic compoſe the pith of the plant are not to be diſcover'd, unle you cut off a piece from the ſeed with a ſharp knife, an place it immediately before the microſcope; for all its moiſtur is ſo ſoon exhal'd, after it is cut, that one cannot poſſibl make any obſervation; moreover, on the 19th of *Novembe* about ſeven o'clock in the evening for further ſatisfaction, h took a little copper-box, into which he put ſome ſcourin white ſand, which was very dry, only that it was ſomewh

moi

PLATE. V

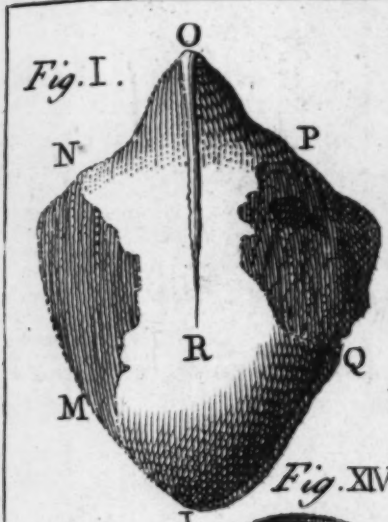




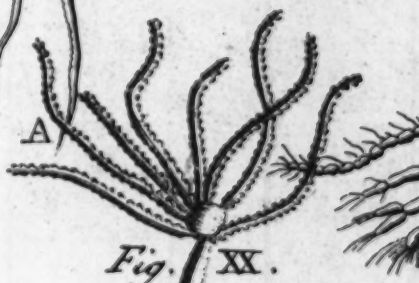


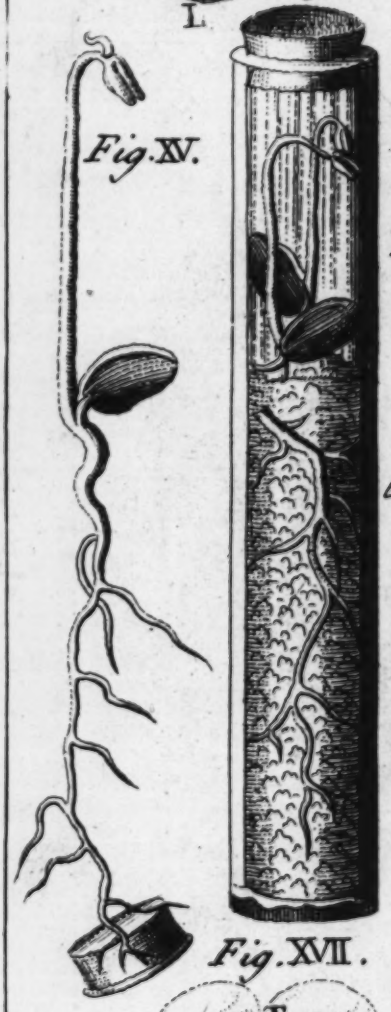




Fig. XI.





















Smith del.

Fig. V.

Fig. VI.

P Q O R

Fig. VII.

C B D A E

Fig. IX.

G F H

Fig. X. B B A B

Fig. XI.

Fig. VII.

V Y W N T X

Fig. XXII.

Fig. XXIV.

Fig. XXV.

Fig. XXVI.

Fig. XXXV.

W E N S

Iun. 28. 29 Iun. 14 Iun. 28

Fig. XXVII.

Fig. XXXVI.

W E

July 5

6 5 4 July 1 30 29 June 28

Fig. XXVIII.

S

Iun. 18 16 15

N c

Fig. XXXIII.

a b

Fig. XXXIV

a b

Fig. XXXII.

a b

c S

Fig. XXXI.

a b c

Fig. XXX.

a b

Fig. XXIX.

a b

Hulett Sculp

moiſten'd by the ſeeds newly taken out of an orange, which he mixed therewith; afterwards, he carried the box in the day time in his fob, and all night he placed it within a large tin bottle fill'd with hot water, by which means the little box was kept warm till the morning; and after repeating this for three days following, he open'd the box, and took out one of the ſeeds, but could not diſcover any change therein; on the 25th of *November* about ſix o'clock in the evening, after that the ſand and ſeeds had been kept ſix days in a continual warmth, he open'd the box again, and he obſerv'd that the root was ſhot forth a ſmall matter out of the membranes of the ſeed, as may be ſeen in Fig. 4; A B being that part of the plant, which was to become the root; and B C D the reſt of the ſeed involv'd in its membranes; moreover, he took another ſeed out of the ſaid box, which having cleans'd from the ſand, and ſeparated from its membranes, he took the two lobes of the kernel that incloſe the plant, as in Fig. 23 and 24, and with fine pins he parted them a little aſunder, to ſhew the top of the plant repreſented in Plate VII. Fig. 25. O P Q.

Fig. 5. E F G H I repreſents the ſeed, which had lain ſix days in the ſand, and was diveſted of its membranes; E F ſhews that part which is deſtin'd for the root; F G and I F are thoſe parts, from which the young plant receives its nouriſhment; and which by two pins K and L are divided from each other, to diſcover that part of the inclos'd plant, which will become the body of the tree, which is repreſented by H, and may be obſerv'd with the naked eye.

Fig. 6. N O P Q R ſhews how far the ſeed can ſhoot out its root in 12 days, which is alſo diveſted of its membranes, and placed ſideways before the glaſs, that the ſtrings, whereby the two parts of the ſeed are united to the plant, may be the more eaſily diſcover'd; N O R ſhews the root; O P and Q R the ſeed or kernel divided into two equal parts; O R the ſtrings united to the plant, from which it draws its firſt nouriſhment; upon cutting thoſe ſtrings a-croſs and cloſe to the plant, he found in each ſtring three veſſels, thro' which he concluded, that moſt of the nouriſhment was deriv'd from the ſeed to the plant; he ſeparated the two parts of the ſeed with two pins, that they might be the better view'd by the naked eye, as may be ſeen in Fig. 7. where S T X ſhews the root; T V and W X the two halves of the kernel, and Y that part which is to become the body of the tree, much larger than H Fig. 5.

After M. *Leewenhoeck* had proceeded with his copper-box, about 18 days, in the manner above-mention'd, he open'd the ſame which is repreſented by Fig. 8. A B C D E; C the ſeeds and plants as ſprung above the ſurface of the ſand. Fig. 9. F G H ſhews the cover of the ſaid box, out of which having pour'd all the ſand, he obſerv'd that all the moiſture was evaporated from it, which doubtleſs was extracted by the ſeeds, of which he had put 16 into the ſaid box; and all of them ſhot out their roots and produced plants, ſome of which were bigger than the reſt; and two or three of the ſeeds produced double plants; and amongſt them was one that yielded three plants.

Fig. 10. A A A repreſents the ſaid three plants; and B B B the three roots; both which were confus'd and jumbled together; which he attributed to the preſſure, and too great nearneſs of the other ſeeds; when M. *Leewenhoeck* obſerv'd how dry the ſand was, which he had pour'd out of the box, he ſuppos'd, that if he had put a little more water into the ſand, or fewer ſeeds, there would have been a greater increaſe both of the plants and roots; therefore he took a glaſs-tube, that was large enough to hold the ſand conveniently, and hermetically ſeal'd at one end, and about twice as long as is here repreſented in Fig. 11. I K L M N O; in this tube he put five or ſix ſeeds, and he laid between each of them a little wet ſand, which was very fine and white, and of that ſort which is us'd for the making of glaſs, which he had always kept dry for above 12 years; he proceeded with this tube, as he had done before with his copper-box, having ſtopped it with a piece of cork as in L P Q M: On the 10th day he obſerved, that the ſeed was come to ſuch maturity, that the part which nature intends for the body of the tree, was grown up as high as the cork; and upon the 12th day it appear'd, as repreſented in the ſaid Fig. R S T; having done this, he took the plant out of the glaſs-tube, which is repreſented in Fig. 12. A B C D E F G H; only obſerve, that this plant had but one root A C D H; but becauſe others had more roots, they are repreſented by B C; here F G ſhews that part which is to be the tree; D E the ſeed or kernel, which being ſurrounded with its membrane, he took off, the better to expoſe to view thoſe parts that ſerve for the nouriſhment not only of the root, but of the upper parts of the plant likewiſe; as alſo the ſhort ſtring D.

Fig. 13. K L M N ſhews a ſmall part of the great root; it appeared as thick and as large as the ſpace between K and N;

and

and the ſmall roots appeared growing out of the ſides of the large root, as is repreſented between M and N: Thus we may ſee with the naked eye, how a ſmall particle no bigger than a coarſe grain of ſand (as the plant is repreſented by C Pl. VII. Fig. 23.) is increas'd in bulk, within the ſpace of 11 days, as has been already ſhewn in Fig. 12. A H G F; and all this is brought about by heat and moiſture in a cloſe veſſel; which is a plain demonſtration, that the plant and all that belonged to it was actually in the ſeed; that is to ſay, not only the young plant, its body, root and fruit, but even its ſeeds alſo, to perpetuate the ſpecies.

In *December* he took another glaſs tube longer and larger than the firſt, as Fig. 14. A B C D E F G H, which he ſtopp'd at both ends with a piece of cork, boring a little hole in the upper cork, he filled the tube a little higher than B G with dry ſcouring ſand, which he firſt moiſten'd with a little rain water; only you are to obſerve, not to make the ſand too moiſt, becauſe the ſeeds will rot; nor too cloſely compreſs it, leſt it ſhould hinder the young plant from puſhing forth its root or branches; in the upper part of this ſand thus diſpos'd, M. *Leewenhoeck* ſet two kernels of an orange brought from *Curacao*, ſome days after they had been taken out of the ſaid orange; and being drier than the others, they conſequently requir'd a longer time before they could ſprout out; but in the ſpace of three weeks, by the warmth of his body only, they germinated, as is repreſented in the ſaid Fig. by B C F G; and pouring out ſome of the ſand, wherewith the ſeeds were cover'd, they appear'd as in B C G; between A B G H are repreſented the long roots with their ſmall twigs and branches againſt the ſides of the tube: Afterwards M. *Leewenhoeck* had obſerv'd but very little change in the plant for ſome days; the reaſon of which, he ſuppos'd to be, that all the moiſture was exhauſted by the plant; wherefore, pouring a little more rain-water upon the ſand, the plant grew bigger; inſomuch, that in five weeks time it was got almoſt to the uppermoſt cork D E; and the roots alſo were ſpread into more branches, and had not only extended themſelves to the lower cork; but one little root had inſinuated itſelf between the cork and the glaſs, and had there ſhot forth another branch; whereas, the external membranes of theſe ſeeds are very thick and hard, and that part of the tender plant, which nature has deſign'd for the tree is not able to perforate or burſt it aſunder, as happens in the plants of nuts, almonds, peaches, *&c.* therefore this

this plant does not ſpring up in a right line thro' the ſeed or kernel, but out of its ſides, as may be ſeen in Fig. 12. between D and F, and in Fig. 15. between N and O.

After that one of theſe ſeeds had lain near ſix weeks, ſhut up in the glaſs-tube, and grown in proportion to that time; M. *Leewenhoeck* obſerv'd, that one of its leaves was withered or corrupted; whereupon, opening both the corks, and pouring out the ſand, which being very dry came eaſily away, a ſmall ſhoot of the root had ſo inſinuated itſelf into the cork, that he could not ſeparate them without ſome violence.

Fig. 15. I K L M N O P repreſents the ſaid whole plant, whereof L M N ſhews the body; M the three leaves it had put forth a-top; I K L the root, with its twigs and ſhoots; L N O the ſeed, or kernel, ſtill ſurrounded with its membranes; and laſtly, I P ſhews the cork that ſtopp'd the bottom of the tube, together with the root ſticking thereto.

Now, if we renew the compariſon (which M. *Leewenhoeck* formerly made) between the *Animalcula in Semine maſculino*, and theſe plants; tho' theſe *Animalcula* are 1,000,000 times ſmaller than a plant in an orange-kernel; and tho' we cannot make our obſervations of the growth and increaſe of the ſaid *Animalcula*, from time to time, in their mother's matrix; yet, we may certainly conclude, that the laws which the wiſe creator of all things has preſcribed to himſelf, in the production both of animate and inanimate creatures, are homogeneous and uniform; and that as the earth is the common *Matrix* of plants, ſo is the *Tuba Fallopiana* in moſt of thoſe animals that are formed ex *Semine maſculino*; for, as the animals in the *Matrix* receive their nouriſhment and increaſe by a ſtring, till they are brought into the world, ſo are all ſeeds (at leaſt, as far as we know) ſupported and nouriſhed by a like ſtring; and the ſeeds thrown into the ground do again, by the ſame ſtring, whereby they received their increaſe, convey nouriſhment to the ſeed or kernel.

M. *Leewenhoeck* had diſcovered, that there are ſome *Animalcula* which have no males amongſt them; and the ſame is alſo obſervable amongſt a few ſpecies of fiſh; theſe *Animalcula* and fiſhes may be compared to ſome ſeeds, which have no other ſubſtance in them, beſides the plant itſelf, and the membranes that invelope it; ſuch are the ſeeds of the beech-tree, as alſo thoſe of creſſes; M. *Leewenhoeck* alſo diſcovered the ſtrings of the walnut and cheſnut-ſeeds, whereby nouriſhment, *&c.* is derived to them.

Now,

Now, ſince M. *Leewenhoeck* could, with a little ſand and water ſhut up in a copper-box or glaſs-tube, and a moderate heat, bring certain ſeeds to maturity, which in our climate are of a long and tedious growth; he from thence concludes, that he knows no other ſecret in vegetation, but a complete heat of the ſun, and a juſt quantity of water; nay, he does not ſtick to ſay, that the increaſe and nouriſhment of all plants is included in water; for, let the barren and unfruitful downs in *Holland*, that conſiſt of a very fine ſand, be brought to ſuch a level, that they lie but a foot higher than the moats and ditches round them, ſo that the rain-water does not drain away as it falls, ſuch land will not only produce good graſs, but even rye, barley, and ſeveral other ſots of grain.

Obſervations upon the Parts and Uſe of the Flower *in* Plants; *by Mr.* Samuel Morland. Phil. Tranſ. N° 287. p. 1474.

IT has been long ago obſerved, that there is in every particular ſeed, a ſeminal plant conveniently lodged between the two lobes, which conſtitute the bulk of the ſeed, and which are deſigned for the firſt nouriſhment of this tender plant; but Dr. *Grew* is the only author, who has obſerved that the *Farina*, or fine powder, which is at its proper ſeaſon ſhed out of thoſe *Thecæ* or *Apices ſeminiformes*, which grow at the top of the *Stamina*, does in ſome meaſure perform the office of a *Semen maſculinum*, which he ſuppoſes only to drop upon the outſide of the *Uterus* or *Vaſculum ſeminale*, and to impregnate the included ſeed, by ſome ſpirituous emanations or emergetical impreſs: What is now the ſubject of enquiry is, whether it be not more proper to ſuppoſe, that the ſeeds which come up in their proper *Involucra*, are at firſt, like the unimpregnated *Ova* of animals; that this *Farina* is a congeries of ſeminal plants, one of which muſt be conveyed into every *Ovum*, before it can become prolific; that the *Stylus*, as Mr. *Ray* calls it, or the upper part of the *Piſtillum* as Mr. *Tournefort* calls it, is a tube deſigned to convey theſe ſeminal plants into their neſt in the *Ova*; and that there is ſuch a vaſt proviſion made thereof, becauſe of the odds there are, whether one of ſo many ſhall ever find its way into, and thro' ſo narrow a conveyance; to make this ſuppoſition the more credible, Mr. *Morland* lays down the obſervations he has made upon the ſituation of theſe *Stamina*, and the *Stylus* in ſome few ſpecies of plants. 1. In the *Corona imperialis*, where the *Uterus* or *Vaſculum ſeminale* of the plant ſtands upon the centre of the flower, from the top of which ariſes the *Stylus*; the *Vaſculum*

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ſeminale and *Stylus* together repreſenting a *Piſtillum*; round this are planted ſix *Stamina*; upon the extremities of each of theſe are *Apices*, ſo artfully fixed, that they turn every way with the leaſt blaſt of wind, being in height almoſt exactly equal to the *Stylus*, about which they play, and which in this plant is manifeſtly open a-top, as it is hollow all the way; to which we may add, that upon the top of the *Stylus* there is a ſort of tuft, conſiſting of pinguid *Villi*, which Mr. *Morland* ſuppoſes to be placed there, to catch and detain the *Farina*, as it flies out of its *Thecæ*; from hence he alſo ſuppoſes, that the rain either waſhes it, or the wind ſhakes it down the tube, till it reaches the *Vaſculum ſeminale*. 2. In the *Capri-folium*, or honey-ſuckle, there riſes a *Stylus* from the rudiments of a berry, into which it is inſerted, to the top of the monopetalous flower; from the middle of which flower are ſent forth ſeveral *Stamina*, that ſhed their *Farina* out of the caſes upon the orifice of the *Stylus*, which in this plant is villous or tufted, upon the ſame account as the former is. 3. In *Allium*, or common garlic, there ariſes a tricoccous *Uterus* or ſeed-veſſel, in the centre of which is inſerted a ſhort *Stylus*, not reaching ſo high as the *Apices*, which thus over-topping it, have the opportunity of ſhedding their globules into its orifice the more eaſily; for which reaſon, he could diſcern no tuft on this, as on the former, to enſure their entrance, that being provided for, by its ſituation juſt under them.

Nothing can be more natural than to conclude, that where a fine powder is curiouſly prepared, carefully repoſited, and ſhed abroad at a peculiar ſeaſon; where there is a tube planted in ſuch a manner, as to be fit to receive it, and ſuch care in diſpoſing this tube, that where it does not lie directly under the caſes that ſhed the powder, it hath a peculiar *Apparatus* at the extremity to enſure its entrance; ſo that nothing can be more genuinely deduced from any premiſes, than it may from theſe, that this powder, or ſome of it, was deſigned to enter this tube; if theſe *Stamina* had been only excretory ducts, as has been hitherto ſuppoſed, to ſeparate the groſſer parts, and leave the juice deſigned for the nouriſhment of the ſeed the more reſerved, what need was there to lodge theſe *Fæces* in ſuch curious repoſitories? They would have been conveyed any where, rather than where there was ſo much danger of their dropping into the ſeed-veſſel again, as they are here; again, the tube over the mouth of which they are ſhed, and into which they enter, leads always directly into the ſeed-veſſel; to which we may add, that the tube always begins to die, when theſe *Thecæ* are emptied of their

con-

contents; if they laſt any longer, it is only whilſt the globules, which enter at their orifice, may be ſuppoſed to have finiſhed their paſſage; now can we well expect a more convincing proof of theſe tubes being deſigned to convey theſe globules, than that they wither, when there are no more globules to be convey'd? And could it be ſhewn that the *Ova*, or unimpregnated ſeed, are always to be obſerved without this ſeminal plant, the proof would ariſe to a demonſtration; but Mr. *Morland* having never diſcerned this, he recommends the enquiry to others; tho' in the mean time, he had made ſome ſteps towards a proof of this ſort, and had met with ſome ſuch hints as made him not deſpair of being able to do it; for, not to inſiſt upon this, that the ſeminal plant always lies in that part of the ſeed, which is neareſt to the inſertion of this *Stylus*, or ſome propagation thereof into the ſeed-veſſel; he diſcovered in beans, peaſe, and *Phaſeoli*, juſt under one extremity of what we call the eye, a manifeſt perforation (diſcernible by the larger ſort of magnifying glaſſes) which leads directly to the ſeminal plant, and at which, Mr. *Morland* ſuppoſes, the ſeminal plant entered; and he is apt to think, that the beans and peaſe which do not thrive, will be found deſtitute of it.

In leguminous plants, if we carefully take off the *Petala* of the flower, we ſhall diſcover the pod, or *Siliqua*, cloſely cover'd with an involving membrane, which, about the top, ſeparates into ſeveral *Stamina*, each being fraughted with its quantity of *Farina*; and theſe *Stamina* are bound cloſe upon the bruſh, which is obſervable at the extremity of that tube, which here alſo leads directly to the pod; it does not indeed ſtand upright, but bended in ſuch a manner, as to make almoſt a right angle with it: In roſes there ſtands a column, conſiſting of ſeveral tubes clung cloſely together, tho' eaſily ſeparable, each leading to its particular cell, having the *Stamina* in great numbers planted all round: In *Tithymalus*, or ſpurge, there riſes a tri-coccous veſſel, that, whilſt it is ſmall and ſo not eaſily diſcernible, lies at the bottom, till it is impregnated; but afterwards, it grows up and ſtands ſo high upon a tall pedicle of its own, as would incline one to think, that there was to be no communication betwixt this and the *Apices*, which he ſees dying below: In ſtrawberries and raſpberries, the hairs which grow upon the ripe fruit, are ſo many tubes, each leading to its particular ſeed; and therefore, we may obſerve, that in the firſt opening of the flower, there ſtands a ring of *Stamina* within the *Petala*; and the whole inward area appears like a little wood of theſe hairs or pulp,

which, when they have received and conveyed their globules, the ſeeds ſwell and riſe in a carnous pulp: Mr. *Morland* from this theory only ſuggeſts, that hence one may conclude, that the *Petala* of the flower were rather deſigned to ſever ſuperfluous juices, from what was left to aſcend in the *Stamina*; than the *Stamina* to perform this office, either for them, or the unimpregnated *Semina*; and he obſerves, that there ſhould be an analogy between animal and vegetable generation. Plate VIII. Fig. 16. repreſents a yellow lilly; A the top of the *Piſtillum* or tube, at which the ſeminal plants are ſuppoſed to enter, and thro' which they are conveyed to the unimpregnated ſeeds in the ſeed-veſſel; *b*, *b* the *Apices ſemini-formes*, which when open, ſhed that powder, which enters the tube at A; C the place of the ſeed-veſſel at the bottom of the tube, the tube-veſſel itſelf being concealed under the leaf in this Fig.

Fig. 17. D repreſents the *Siliqua* in a flower of a pea-kind; E the tube which ariſes from the *Siliqua*, and conveys the plants thereto; F the membranous coat that involves the *Siliqua*, laid open; *g*, *g*, *g*, *g* the *Apices*, which, before the membranous tegument is laid open, appear to ariſe from its edges, and by the *Petala* of the flower, are kept cloſe upon the orifice of the tube, that they may conveniently ſhed their *Farina* into it.

Fig. 18. a *French*-bean repreſented ſide-ways.

Fig. 19. the ſame opened; *h* the ſeminal plant; *i* a perforation, at which it is ſuppoſed the ſeminal plant firſt entered.

An Experiment to diſcover the Cauſe of the Motion of the Dura Mater; *by Dr.* Ridley. Phil. Tranſ. N° 287. p. 1480. *Tranſlated from the* Latin.

DR. *Ridley* having read (in *Baglivi*'s book *de Fibrâ motrice*) a new hypotheſis different from what the Dr. had ſome time before laid down in his *Anatomia de Cerebro*, *Cap.* 6. concerning that alternate motion of the *Dura Mater*, which is viſible to the naked eye in wounds of the brain, and in animal viviſection; he thought it incumbent upon him, without taking any notice of the conſequences of *Baglivi*'s hypotheſis (which may, perhaps, be true, tho' it ſhould be ſuppoſed that the *Dura Mater* does derive its motion from ſome other cauſe, than from itſelf) to review what he had ſaid upon this ſubject: *Baglivi*, beſides ſeveral other places of his book, has the following paſſage in *p.* 20. *As ſoon as I ſaw this boy*, ſays he, *I immediately concluded, that the* Dura Mater *did not derive its ſtrong and alternate motion from the arteries, which are diſſeminated thereto*

therein, but from its own peculiar contexture, which emulates that of the heart; and a little above he calls the dura Mater *the heart of the brain; and afterwards,* p. 29, *wherefore* says he, *the cauſe of the pulſation of the* Dura Mater, *is to be ſought for in its whole bulk and proper ſubſtance, and not from any external cauſe.*

Dr. Ridley *in his book,* cap. 6. *ſpeaks to the following purpoſe; moſt of the ancients, as alſo ſome of the moderns, eſpecially the famous Dr.* Willis *and* Vieuſſens, *have aſcrib'd the* Syſtole *in theſe* Sinus's *to be owing to ſome arteries that terminate therein; but I being a little doubtful on this head, made the following experiment; having tied and conveniently placed a dog, and taking away a portion of the ſcull, I could not obſerve any pulſation either in the* Dura Mater *or its longitudinal* Sinus; *but in a little time after, the ſaid* Sinus *burſting by the accidental touch of a red hot iron, there was a great effuſion of blood, and it was after a conſiderable depletion of the veſſels, that the blood flowed in a ſalient manner, with an obſervable pulſation in that* Sinus *and in the whole* Dura Mater; *I cut this* Sinus *lengthwiſe, in order to trace (but all to no purpoſe) amidſt this ſalient ſtream of blood, the inſertion of ſome arteries, ſeveral of which* Vieuſſens *and before him the learned* Wepfer *affirm'd they had ſeen inſerted therein; from hence it appears evident, contrary to the opinion of* Bourdon, *that theſe* Sinus's *according to* Fallopius. Volch. Coite *and others have no other motion, but what is communicated to them, in common with the* Dura Mater, *from the arteries diſſeminated thro' the ſubſtance of the brain, and by a ſort of co-operation, from the arteries in the membrane itſelf;* for further ſatisfaction, the Dr. made the following experiment on a dog; having perforated the ſuperior part of the *Bregma*, he laid bare the *Dura Mater*, not without ſome effuſion of blood; and ſtopping directly the hæmorrhage with lint, and wiping off the blood, the *Syſtole* of this membrane, as alſo of its longitudinal *Sinus*, which went along the edge of the perforation, correſponded exactly to the pulſation of the heart, which was quicker than ordinary; this pulſation continu'd $\frac{1}{4}$ of an hour, after which the Dr. laid hold of the membrane with a ſharp hook, that by keeping it ſuſpended thereby, and dividing it with a knife, he might the better find out the motion of the brain beneath it; after making a perforation (of which the dog ſeem'd to have a very quick ſenſation) there enſu'd an hæmorrhage, which was ſoon ſtopp'd as before, yet without

any convulsions; after wiping off the blood, the *Systole* of the brain appear'd to force out, at the little hole which was made in the *Dura Mater* by the puncture of the hook, that little quantity of blood that remained therein; then carefully introducing the blunt point of a pair of sciſſars into the aperture of the wounded membrane, he cut it transversely, on the side that was furtheſt off from the longitudinal *Sinus*; whereupon, the brain envelop'd in the *Pia Mater*, came thro' that aperture, its motion ſtill continuing ſtrong to the touch, tho' the membrane itſelf appear'd to the naked eye to have but a weak vibration, becauſe the elaſtic power of its fibres was diminiſh'd by the wound; all this time the dog was lively, being only affected with ſlight tremors, and with a kind of ſhuddering all over his body; after ſpending ſome hours in obſerving theſe things, during which the animal had been variouſly excruciated, and loſt a good deal of blood; at length, in order to deſtroy the *Vis Pulſifica*, which might be ſuppos'd to be either inherent in this membrane, or to be deriv'd to it from ſome other part by means of its fibres, he gently pour'd a few drops of the oil of vitriol upon it, whereby it was tinged black; after this it had no vibration, at leaſt none that was very perceptible; yet notwithſtanding this, its unfitneſs to obey the impulſe of the brain, upon applying the finger, the pulſation of the brain was felt ſufficiently diſtinct; afterwards, the dog ſtill continuing lively, upon plunging the point of his knife an inch deep into the ſubſtance of the brain, the animal made violent agitations, and fell into a horrible toſſing of his body, and into convulſions of his fore and hinder legs; and at that time putting his finger as before, into the ſaid aperture, he felt a ſtronger pulſation ſtill; then forcing a probe deeper down, the animal gave ſigns of exquiſite pain; at length running the knife thro' the brain quite to the oppoſite ſide of the ſcull, horrible convulſions enſued; and now to remove all doubt about the motion of the brain, both the Dr. and the by-ſtanders felt a very ſtrong *Syſtole* and *Diaſtole*.

Amidſt ſeveral authorities the Dr. might give, he only quotes the following obſervation made by *Theodore Moeren*, in the *Miſcellan. Curioſ. German. Decur.* 2. *An.* 4. *Anno* 1685. *Obſ.* 129. *This great contuſion had burſt, ſays he, both the* Dura Mater *and* Pia Mater, *and confounded the very ſubſtance of the brain; and the blood which had inſinuated itſelf into its glandulous cavities, was gently dried up with cotton faſtened to a ſtyle; after that, cleanſing the wound and making proper appli-*

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cations both internally and externally, we roll'd bandages round the head; what was ſurpriſing was, that the ſubſtance of the brain, by its continual pulſation, had acquired a fungous protuberance, which requir'd to be cut twice every day: Dr. Ridley himſelf had formerly ſeen a like inſtance, wherein the patient was for ſome time dreſs'd every day by a ſkillful ſurgeon.

As to the office aſſign'd this membrane by *Baglivi*; *viz.* that thereby the cortical ſubſtance of the brain being more cloſely compreſs'd, the more animal ſpirits are produced and convey'd to the remoteſt nervous parts of the whole body; the Dr. would have it to be firſt obſerved; into how many various ramifications the carotid arteries (as ſoon as they arrive at the brain) are propagated thro' all its parts both medullary and cortical; ſo that according to *Malpighi* they make a third of all the arteries in the whole body; which computation the Dr. found to be pretty near the truth, after injecting them with red wax. 2. He obſerves that the *Cortex* of the ſpinal marrow (where we muſt neceſſarily allow that the animal ſpirits are both generated and conſtantly diſtributed) has an inverted ſituation, being internal; and, that the medullary part, from which the nerves proceed, is external; ſo that the application is eaſy.

Remarks on M. Leewenhoeck's *Obſervations on* Green-weeds *and* Animalcula. Phil. Tranſ. N° 288. p. 1494.

OUR author obſerv'd the ſame *Animalculum* M. *Leewenhoeck* ſpeaks of Phil. Tranſ. N° 283. which he found in the beginning of *June* in ſome clear water, he took up in a ditch at *W*——, in which, with his utmoſt attention, he could diſcover no more than this ſingle one of the ſame kind.

Plate VIII. Fig. 20. repreſents it in one of the poſtures it appear'd in the firſt day, (for it varies every moment) and the knob at *a*, which look'd like the gut *Cæcum*, was ſometimes a little more lengthen'd; two days after, he could perceive two or three white fibres at the extremity thereof; and on the fourth day, the animal lying ſtretch'd at its full length, appear'd as in Fig. 21.; and he plainly ſaw, that what he ſuppos'd an excreſcence was a young one, with ſix horns, coming out of the ſide of the old one; and the next day he found it in the water entirely ſeparated from its body, and it was about $\frac{1}{3}$ of the length of its parent; the formation of the horns are well repreſented by M. *Leewenhoeck*; and they iſſue like radii, not from the extremity, but quite round a ſmall knob, which

which our author takes to be the head; the horns have a vermicular motion, and are extended or contracted both all together and ſeverally; the other extremity is flat, which it often faſten'd like a leech, to the bottom or ſide of the glaſs in which he kept it; it alſo contracts and dilates its body at pleaſure, and eſpecially, when touch'd or diſturb'd, it will bring both body and horns into a ſmall compaſs, and has then the appearance of Fig. 22. and 23. the horns are perfectly white, and the body yellowiſh, and not eaſily diſcernible in the water by the naked eye, it being when extended, no thicker than a large horſe-hair.

The ſmall plant mention'd in the ſaid Tranſ. is the *Lens paluſtris* or duck-weed, which floats plentifully on our ponds or ditches; but our author diſſents from M. *Leewenhoeck*, where he ſays it does not come originally from the bottom; for ſeveral years ago, *W*—— *Ch*—— Eſq. ſhew'd him the manner of its ſpringing out of the mud; and they often obſerv'd, that when the leaves were grown to a competent ſize, the force of the water eaſily drew up the minute ſingle-fibred root, and rais'd the plant to the ſurface; our author acknowledges, that the leaves when floating, continue to grow, and may be increas'd in the manner M. *Leewenhoeck* mentions; and he has often taken the young plant, which M. *Leewenhoeck* has repreſented, out of them, ſo that they may be call'd ſeeds more properly than leaves; and our author's opinion is, that towards the end of the year, upon their corruption they ſink to the bottom, and take root there, ſo as to continue the ſucceſſion.

The *Animalcula*, which M. *Leewenhoeck* deſcribes ſticking to the root of the plant, our author has often obſerv'd, not only in water-plants, but adhering to the bodies of ſeveral ſorts of water-inſects, which he has ſeen cover'd almoſt all over with tufts of them; each tuft conſiſting of ſeveral *Animalcula*, which appear not much unlike the flowers of a lilly or fox-glove; this congeries of *Animalcula* will lengthen and contract themſelves both all together, and ſeverally; and he has obſerv'd, when they lie at length, that they exert exceedingly minute organs, like ſmall feet (not eaſily diſcernible even with his beſt glaſſes) which by their quick agitation bring a current of water from all ſides towards them; but he never ſaw that motion in them, which M. *Leewenhoeck* ſays, reſembles that of a mill-wheel; nor indeed, can he perceive the poſſibility of ſuch a rotation of any member in an animal mecha-

mechaniſm; but he thinks, he can eaſily account for this miſtake of M. *Leewenhoeck*'s, or rather of his painter; for in the ſame water, wherein he has ſeen theſe plants and *Animalcula*, he obſerv'd a ſmall round animal, whoſe numerous legs ſtand like *Radii* all round its body, this has a ſwift progreſſive motion, but will very often lie ſtill (when only you can perceive thoſe *Radii*) and then turn very ſwiftly round like a wheel, ſometimes one way, and then ſtop and turn the other way, without ſtirring an hair's breadth forwards; now it is very probable, that one of theſe might ſhew its motions ſo very near to or amongſt a tuft of the other fix'd *Animalcula*, that it might be very readily taken for part of the ſame, and he is very confident this is matter of fact: Theſe *Animalcula* are ſometimes ſeen looſe; but generally, they are faſten'd in cluſters by their tails to other bodies, and perhaps, cannot ſeparate themſelves; and our author takes it to be no mean inſtance of a providence, that ſeveral kinds of water-inſects, which are ſo fix'd, and even ſome of which have but ſlow and irregular motions, are furniſh'd with ſuch organs about their head, the vibration of which brings a conſtant current towards their mouths, and with that food for their ſupport; otherwiſe, they would be ſtarv'd for want of nouriſhment: The inſects on which he has ſeen theſe *Animalcula* are of divers ſorts; and he has obſerv'd no ſmall variety in the water of our ditches, not only of reptiles, and the caterpillar kind, but of eels and perfect ſhell-fiſh, both cruſtaceous and teſtaceous; Fig. 24. and 25. repreſent two ſorts of the cruſtaceous kind, as they lie in a ſwimming poſture, with their backs towards you; but the members and legs on the other ſide are ſo various, and ſo much more curiouſly form'd, than thoſe of lobſters and ſhrimps, that he deſpair'd of giving any tolerable repreſentation of them in any other poſition; theſe are about the ſame ſize, the biggeſt being rather leſs than a very ſmall flea, and the leaſt a little bigger than a mite; but all are breeders, and carry their ſpawn at their tails; that repreſented by Fig. 24. carries it in two bags, one on each ſide; which are faſten'd about the fifth joint, and the other in a ſingle bag or film under the tail; and he has often ſeen theſe bags broken, and the ſpawn (which is globular and large in proportion to the fiſh) ſcatter'd thro' the water; there is alſo amongſt theſe a third ſort of the ſame kind, not leſs elegant, tho' far leſs in bulk, which is ſhap'd more like a ſhrimp, and alſo carries its ſpawn like that; all theſe three ſpecies, as alſo ſome other water-

inſects,

inſects, are certainly monoculous, and have their eye exactly in the middle of the head; and he could never, with his utmoſt application, find ſo much as a dividing line therein; ſome of them, eſpecially in ſome waters, are dark and cloudy; but generally, they are ſo tranſparent, that thro' the ſhell he could ſee the periſtaltic motion quite thro' their whole length, and a conſtant pulſation of a part, which he took to be the heart; but he could never diſcover any circulation of blood in them (nor even in ſhrimps, which are as big as ſome thouſands of theſe) tho' he had ſeen it plainly in animals a little bigger; *viz.* the ſmalleſt new-hatch'd ſpiders, and in that water-inſect which is deſcrib'd and repreſented, tho' not accurately, by *Swammerdam* under the improper name of *Pulex aquaticus*; but this is of the teſtaceous kind, of which our author has ſeen a greater variety, and not leſs curious than thoſe of the cruſtaceous kind.

Our author farther obſerv'd the *Lens paluſtris*, and he is fully ſatisfied of the truth of its firſt ſpringing from the bottom; he took up ſome on the ſhallow ſide of a pond, and found the extremities of the ſtalks (moſt of which were at leaſt five inches long, and as thick as a ſtrong horſe-hair) manifeſtly rooted in the bottom, ſo that he could not take them up, without raiſing the mud at the ſame time, which alſo adher'd very viſibly to them; theſe ſtalks or roots are of a curious texture, and almoſt tranſparent; and he has ſeen their outſide very prettily cover'd with a regular ſort of net-work; M. *Leewenhoeck*'s figure repreſents them but badly; in his obſervations of theſe ſtalks, our author often ſaw adhering to them (and ſometimes ſeparate in the water) ſeveral pretty branches, compos'd of rectangular parallelograms and exact ſquares, which were join'd together, as in Fig. 26; there are often 20 or more of theſe figures in one branch, which generally adheres at one extremity to the ſtalks of the plant; and it is remarkable, that theſe rectangular parallelograms are all of the ſame ſize; the longeſt ſide does not exceed $\frac{1}{5}$ of a hair's breadth, and the length is juſt double the breadth, the ſquares being viſibly compos'd of two parallelograms join'd lengthwiſe; they appear very thin, and the texture of each is nearly the ſame; to a very large magnifier they appear as in Fig. 27; he took theſe branches at firſt for ſalts, but upon finding them always of the ſame ſize, and that there was no ſenſible increaſe of their bulk, while they continu'd in the water; that after they had lain a day or two dry on a glaſs-plate, they did not

not alter their figure, and upon the addition of new water, warm or cold, they ſtill had the ſame appearance and coheſion, and that their adherence (tho' touching only in the angular points) was ſo firm and rigid, that all mov'd together, and kept the ſame poſition in reſpect of each other, however agitated by the water; theſe conſiderations perſuaded him, that they might be plants, rather than ſalts; but they being ſo very minute, that no judgment could be made of them, but by the eye, he would not determine any thing poſitively.

In ſome water which he took out of a pit, he found a ſmall *Water-newt*, not an inch long, which he took to be of the ſame year's brood; and the legs being ſo ſmall, as not to be readily diſcern'd at firſt view, and the body being very clear, he at firſt ſight took it for a fiſh; this he kept by him (inſtead of tadpoles) to ſhew the circulation of the blood in its tail; and not only ſo, but he found the circulation of the blood in every part of its body, and particularly in every toe of the feet; it was a curious ſight to obſerve, the ſtream come to the extremity of the toe in one channel, and return by another; in this *Newt*, juſt below the ſetting on of the head, on each ſide, are three little rugged fleſhy branches, which it ſpreads like fins, and they help to poiſe its body, obſerving theſe with the microſcope, he found each of them divided (ſomething like a leaf of polypody) into a great many pointed branches; in each of which as in the toes, he could ſee the blood come to the extreme point on one ſide, and return on the other; and 30 or 40 of theſe branchings would ſometimes appear at one view, and the blood be ſeen diſtinctly circulating in all; for as Mr. *Cowper* rightly obſerves, the globules of the blood of theſe animals are very large, ſo that he could ſee the circulation in them very well, even with the ſmalleſt magnifiers, which take in a large area; and from what has been ſaid of this circulation of the blood, our author is perſuaded, that theſe organs in the *Newt* are not only deſign'd to be ſerviceable in their ſwimming, but (tho' they have lungs like a frog) may alſo be analogous to the gills in fiſhes.

In his examination of the waters of our ditches (in which he daily found new varieties of *Animalcula*) he met with great numbers of thoſe round bodies ſo well deſcrib'd by M. *Leewenhoeck* Phil. Tranſ. N° 261; and whilſt he was obſerving them he ſaw a very ſurpriſing *Phænonenon*; *viz.* each of thoſe ſpherical bodies (which are ſmaller than a muſtard-ſeed) had a conſtant progreſſive motion, and at the ſame time a ſlow

revolution about their own axis, and contained within them other ſmall globules, ſome more, ſome leſs; but he never found above ten in one; and theſe he has ſeen move and change their poſition within the other, which M. *Leewenhoeck* ſays he never obſerv'd; while our author had one of theſe bodies on a glaſs-plate before his microſcope, he ſaw (as M. *Leewenhoeck* deſcribes it) one of the contained globules ſlip out of it; and while the large one lay ſtill, for want of ſufficient water to float in, this ſmall one that came out had immediately a very quick rotation on its axis; and what was moſt ſurpriſing, at the ſame time it kept an equable revolution about the larger globe, as the centre of its orbit, always very nearly at the ſame diſtance, tho' he could not perceive any vortex in the water which bore it; and what was ſtill more remarkable, he ſaw it ſtop, and then make its revolution round the central body the contrary way, the rotation on its own axis always continuing; and when the water was ſo far evaporated, that all lay at reſt, by the addition of more water the ſame motions were renewed; this he thought a very pretty repreſentation of the planetary motions about the ſun; our author thinks, that it is not eaſy to account for the motions of theſe globules; nor will he, to ſolve the difficulty, ſay in contradiction to M. *Leewenhoeck*, that he takes them to be animate, tho' he has formerly ſeen ſome not very unlike them both in ſhape and motion, which he was ſatisfied were animals.

Our author found all the earwigs, which he examined by a microſcope, infeſted with great numbers of minute inſects, which ſtick like lice on ſeveral parts of their bodies, and eſpecially juſt under the ſetting on of their heads; they are alike on all, and he never found the ſame on any other animal; they are white and ſhining like mites, but much ſmaller, are round-back'd, flat-bellied, and have long legs, eſpecially the two foremoſt ones.

Spots *obſerved in the* Sun; *by Mr.* Stephen Gray. Phil. Tranſ. N° 288. p. 1502.

JUNE 15th, 1703, between 4 and 5 o'clock in the afternoon, Mr. *Gray* ſaw a ſpot in the ſun, by placing a piece of white paper ſo far behind the teleſcope of ſix foot, as to give the image of the ſun nine inches diameter; the ſpot was in the lower right hand quadrant of the ſun's diſk, its form was almoſt round, inclining to an ellipſis; it was diſtant from the limb of the ſun about ſix or ſeven inches, and its diameter he judged to be about 10 or 12 ſeconds; a little before the ſetting of the ſun, he ſaw the ſpot with a 16 foot teleſcope, and he could perceive that it was

ſur-

ſurrounded with a miſtineſs; on the 16th he ſaw the ſpot again about two in the afternoon, and found that it had advanced near the weſtern limb of the ſun; the 17th was cloudy, and ſo was the night, which hindered Mr. *Gray* from obſerving the eclipſe of the moon; the 18th, in the afternoon, it cleared up, and a little before five, he ſaw the ſpot with the 16 foot teleſcope thro' thin clouds, and he found that it was now very near the limb of the ſun, little more than half a minute; it was much contracted in its breadth, ſo as to be four or five times longer than it was broad; on the 19th, in the morning, he looked for it again, but he could not ſee it; ſo that Mr. *Gray* concluded, it was then either gone off the diſk of the ſun, or if it adhered to the limb, the great tremulation of the atmoſphere hindered him from ſeeing it.

Aſtronomers have found by theſe ſpots, that the ſun revolves upon its axis, ſo as that in 27 days, the ſame point in the ſun's diſk returns to the ſame place it was ſeen at from the earth; hence its ſemi-revolution is in 13 days and a half; and conſequently the ſpot going off the ſun's diſk the 19th of *June*, it might be expected to return the 2d of *July* following towards the eaſtern limb of the ſun's viſible hemiſphere, if it be not diſſolved before that time.

Plate VIII. Fig. 28. expreſſes the appearance, but not having the conveniency of meaſuring the angle of the ſpots way with the vertical, it is only gueſſed at.

June 26th, 1703, in the evening, Mr. *Gray* looked, whether there were generated any new ſpots in the ſun, but he found none; on the 27th, about half an hour after eight in the morning, by receiving the ſun's image on white paper from the 6 foot teleſcope, he ſaw a ſpot near the ſun's vertical towards the lower limb; betwixt nine and ten he elevated the 16 foot teleſcope, the clouds being now of a convenient thickneſs to let him view the ſun, he found that this ſpot was of a triangular form, and that it was accompanied with two other ſmaller ones, as expreſſed in Fig. 29; the ſides of the large ſpot were curvilinear, and this with two ſmaller ones made an equicrural triangle; at four in the afternoon, the triangular ſpot had a ſmall fragment ſeparated therefrom, and itſelf was now become elliptical; the ſpot *b* was much augmented, but the ſpot *c* was diminiſhed, and became longiſh, as in Fig. 30; at half an hour after five, the fragment from the large ſpot was divided into two, and the ſpot *c* was ſo narrow, as to be ſcarcely viſible, as at Fig. 31; about 30 minutes after 6 o'clock, there was a ſmall fragment ſeparated

from the lower extremity of the large ſpot, as in Fig. 32; at 7 o'clock the ſpot C was much increaſed, but *c* was vaniſhed, the obſervations were made this afternoon with the 16 foot teleſcope, when the air was clear, and to ſecure his eye, Mr. *Gray* ſmoaked the eye-glaſs with a wax-candle; the 28th, about ſeven in the morning, he ſaw that the large ſpot was much augmented, but the ſmaller ones that attended it the day before, were vaniſh'd; and there were two new ones generated at about one minute and a half diſtant from the large one below, and towards the left hand thereof, the large one was a paralellogram, with a black diagonal croſſing it, as repreſented in Fig. 33; at 10 o'clock there was another diagonal croſſing the former, as in Fig. 34; and the two ſmaller ſpots, which before had been longiſh, had now aſſum'd a round form, the ſpot *c* being much larger than the other at *b*: Mr. *Gray* not having proper inſtruments to find the poſition of the ſun's ſpots, with reſpect to longitude and latitude on the ſun's diſk, he could only obſerve the poſition and variation of the ſpots amongſt themſelves.

The Same; by Mr. William Derham. Phil. Tranſ. N° 288. p. 1504.

THE two circles in Plate VIII. Fig. 35, 36, repreſent the ſun's diſk; N the northern part thereof, S the ſouthern, E the eaſtern, and W the weſtern part; wherein alſo are repreſented the place of the ſpots, the manner of their appearance every day, and the day of the month: It is to be obſerved, that tho' the figures of the ſpots are done pretty exact, yet their places on the ſun's diſk are not ſo, for being unprovided with the proper inſtruments, Mr. *Derham* was obliged to repreſent them, by taking the ſpecies of the ſun upon paper thro' a teleſcope, and ſo marking out their places; ſince the laſt appearance of the ſpots, he invented an exceeding nice micrometer, and provided himſelf with a watch that beats half ſeconds; this micrometer is not, as uſually, to be put into a tube, but is to meaſure the ſpecies of the ſun of any *Radius*, or paper, or any part thereof, which Mr. *Derham* takes to be more exact than the common way; by this means he can eaſily and very exactly, with the help of a fine thread, take the declination of a ſpot at any time of the day; and by his half-ſecond watch, and a fine croſs hair, he can meaſure the diſtance of the ſpot from the ſun's eaſtern or weſtern limb; this croſs fine hair ſhould be ſet, not at the exact focal diſtance from the eye-glaſs, as uſually, but a little out of that diſtance, nearer towards the object-glaſs, becauſe the

the ſhadow of the hair will thereby be much narrower, and appear the more diſtinctly croſs the ſpecies of the ſun received on the paper; and this method may likewiſe be of good uſe in taking the ſun's altitude, meaſuring his diameter, &c. being a more eaſy, and perhaps, a more exact way than by looking thro' a tube: The ſpots on the ſun's diſk ſeemed ſtrong enough to have laſted another, or more revolutions, but none have been viſible ſince the 6th of *June*, when Mr. *Derham* had a glimpſe of a ſpot on the ſun's weſtern limb, about 7 o'clock in the morning.

The ſpot in Fig. 35, appeared as it is there repreſented, firſt round and ſtrong, afterwards long, and with a *Nucleus*; this very ſpot Mr. *Derham* doubts not, but he ſaw again on the ſun's eaſtern ſide *July* the 5th, but very faint, ſmall, and long, as in Fig. 36, ſo as to be but juſt diſcernible; on *July* the 6th it quite diſappeared, both thro' his tubes, and on paper: The ſpots in Fig. 36, had theſe remarkable appearances and variations; on *June* the 28th, viewing the ſun towards evening, he eſpied a large ſtrong dark ſpot, with two or more glaring *Nubeculæ* behind it, ſomewhat like the repreſentation in the figure; theſe were become next day four ſtrong dark ſpots, the foremoſt had a tail to it, conjoining the little ſpot next it, as in the figure; on *June* the 30th, he ſaw ſpots, but it being a cloudy morning, and being abſent from his tubes in the afternoon, the repreſentation of them in the figure is not exactly as they appeared; *July* the 4th, there appeared between two long ſpots, ſomething reſembling a round *Nubecula*, as in the figure; the reſt were as repreſented in the figures.

The Invention and Progreſs of Printing *to* Anno 1465. Phil. Tranſ. N° 288. p. 1507.

WHAT Mr. *Ellis* ſays, *Phil. Tranſ.* N° 286. about the books printed at *Haerlem* by *Laurentius Coſter*, agreeing ſo well with the accounts given by *Theodore Schrevelius* and others, leaves us no room to doubt, whether the honour of the invention be due to this or the other cities, whoſe writers have ſo eagerly contended for it, ſince none of them have pretended to ſhew any book printed ſo early as *A. D.* 1430 or 1432, or near that time; but the difficulty lies, either in ſhewing, why the practice of this art ſhould be at a ſtand from *A. D.* 1432, to the noted reviving of it at *Mentz* by *John Fuſt* and *Peter Schoeffer*; who (as it has been vulgarly, but erroneouſly ſaid) printed the firſt book there, namely, *Tully's Offices*, *A. D.* 1465; or

or elſe, in giving any tolerable account of the progreſs of this invention, during an interval of above 30 years.

Boxhornius, as well as *Schrevelius* and other authors, expreſly ſay, that *Coſter* could not advance this invention ſo far, as to print ſo large a work as the *Speculum Salutis*, without gradual improvements; and that his firſt eſſays were on looſe and ſmall leaves of paper, (moſt of which by being ſo, are all ſuppoſed to be loſt) before he had attempted whole books; but this gentleman had once obſerved a looſe leaf of paper in *Octavo*, lying in an old MS breviary, in her majeſty's royal library at St. *James's*, which he ſuppoſed to be one of *Coſter's* firſt pieces, done when he had attained to ſome experience in the art, and to get money; it is a rude ſmall wooden cut of the five wounds of our Bleſſed Saviour, and the inſtruments of his paſſion, with a *Latin* inſcription at the bottom; to this purport, that ſuch as would ſay ſo many *Ave Maria's* before it, would have ſo many 1000 years pardon; the ink in this cut or print was writing-ink, and it was all black, without thoſe other colours wherewith *Coſter* afterwards adorned his books: In the above-mentioned *Boxhornius's* book *de Origine Artis Typographicæ*, it is ſaid, that *Hadrianus Junius* had a book printed by *Coſter*, and like that kept in the cheſt at *Haerlem*; now, amongſt thoſe books bequeathed to the *Bodleian* library at *Oxford* by Mr. *Francis Junius*, (a kinſman of *Hadrian's*) there is a thin ſmall *Folio* numbered 31, which may probably be the ſame, and which one Mr. *Foſs* a *Dane*, aſſured this gentleman was very like that at *Haerlem*; this contains the ſum of the hiſtory of the old teſtament, repreſented in rude wooden cuts, coloured with divers colours, without any ſhading, reſembling our cards (which, with ſheet-ballads, are remains of the old manner of printing) and ſtamp'd on one ſide only; the white ſides of two leaves being paſted together; the black both in the pictures, and in the inſcriptions which ſhew their meaning, being writing-ink (as in the aforeſaid leaf) is artificially ſpread upon the wooden block, here thick and there thin, ſpreading and yellowiſh; the letters are extremely rude, and altogether manifeſtly ſhew, that the art was yet in its infancy; the ſtamping of this book on one ſide only, was not, becauſe the printer did not know how to diſpoſe the pages in ſuch a manner, as might be proper and eaſy for the book-binder's uſe; for it has its ſignatures all along in majuſcule letters, ſet in the middle of the page; but becauſe, it was thought, that the paper would not bear a ſecond impreſſion on the backſide; juſt as the book-writers of thoſe times (when paper began to be cheap, and to be made

up

up into books) would yet have the firſt and laſt leaf of each *Quaternio*, *Senio*, &c. to be of parchment for ſtrength ſake: This book is imperfect, and has no date now appearing, and perhaps never had any; nor has ſuch another book as this, which contains the hiſtory of St. *John* and the *Apocalypſe*, in ſuch like wooden-coloured pictures and inſcriptions; this is inſcribed LAUDE 65, and it is in the ſame *Bodleian* library, and has alſo its ſignatures in majuſcule letters; which this gentleman obſerved in ſeveral MSS of different ages, as high as 1000 years ago and upwards, expreſſed either by letters or numbers; this book, tho' printed but on one ſide, and paſted as the former, is yet more elegant, and ſhews that the art was much improved; and in the ſame library *Arch. B. Bodl.* 88, there is an ancient MS, with the ſame figures and inſcriptions, tho' the habits of the figures are different, being of an older faſhion; and it is very likely, that there is another copy of this book in the emperor's library at *Vienna*; for, *Lambecius*, in his *Comment. de Biblioth. Cæſ. Lib.* 11. *p.* 772, reckons, amongſt thoſe which he brought away from the arch-ducal library at *Inſpruck*, a book of which he gives the following account; *Apocalypſis S. Joannis Apoſtoli & Evangeliſtæ Latino-Germanico, chartacea in Folio, una cum Vitæ ipſius, & multis figuris ligno inciſis, quæ propter vetuſtatem ſuam ſpectatu ſunt digniſſimæ*; and in this book at *Oxford*, beſides the printed cuts, there is alſo a commentary upon the *Apocalypſe* in *High Dutch*; beſides theſe two very ancient printed books, Mr. *Bagford* told this gentleman, that in the manuſcript library of *Corpus Chriſti* or *Bennet-College* in *Cambridge*, he ſaw a third, containing the hiſtory of our Saviour, printed only on one ſide of the paper, with ſuch like wooden cuts, but yet more neatly done, than either of the former at *Oxford*; and theſe three books, being ſtamped but on one ſide of the leaf, the whole being wrought or cut upon wood, not ſet or compoſed with printing letters, and printed with writing-ink, do ſufficiently demonſtrate, that the art was as yet in its infancy; and may, tho' they bear no workman's name, be very reaſonably aſcribed to *Coſter*; not only, becauſe no other perſon lays claim to them, but becauſe, in divers circumſtances, they agree with the hiſtory of the man, and with what remains of his workmanſhip: If it be aſked, why *Coſter* did not ſet his name and the date to theſe books, as well as to that at *Haerlem*, mentioned by Mr. *Ellis?* It may be anſwered, that *Schrevelius* tells us, that *Coſter* bound *Fuſt* above-mentioned by oath to ſecrecy, and not to betray the art to any perſon whatſoever; wherein it is likely, that

that his deſign was not ſo much to let the world think, that he had a new way of multiplying the copy of a book much quicker than the quickeſt penman, but that he deſigned to impoſe upon the world, by ſelling his printed books for new written copies; whereby the book-writer and illuminator muſt (as he might well pretend) be ſo paid for their work, as to maintain themſelves and families; this trick might for a long time be undiſcovered in and about *Haerlem*, becauſe there was no other printing, whereby this might be contradicted; but at length, as *Boxhornius* and *Schrevelius* write, *Fuſt* run away with all his maſter's tools and materials, and in proceſs of time he ſet up a printer's ſhop at *Mentz*, aſſiſted by his ſervant *Peter Schoeffer*, a young man of a good genius; who afterwards married his daughter, and became his partner in the buſineſs: The ſtory goes, that this *John Fuſt* went to *Paris* (but whether before or after his ſettling at *Mentz* our author cannot tell) and that he there offered a great number of printed bibles to ſale, as if they were manuſcripts; but the *French*, conſidering the number of theſe books, and their exact conformity to each other throughout the whole, to a line, a word, a letter, a point; and that the beſt of book-writers could not be thus exact; and therefore by indicting him (or threatening to do it) of diabolical magic, they at once gave birth to the ſtory of Dr. *Fauſtus*, and obliged him to diſcover the art; and our author does not doubt, but that, about this time, a great many books were printed and ſold for manuſcripts; he having ſeen divers ſuch books without dates, which looked rather older than any he ſaw with them; thoſe our author now ſpeaks of, are ſet or compoſed of letters, which, together with printing ink, made of lamp-black and oil, and the printing-preſs, is ſaid to be the improvement of *Schoeffer* above mentioned; tho' *Schrevelius* with leſs reaſon aſcribes the two former to his countryman *Coſter*.

When *Fuſt* and *Schoeffer* began firſt to work at *Mentz* is uncertain; but the firſt mention our author finds made of him, is in *Schrevelius's Haerlem*, p. 272, where he ſays, that this *Fuſt* or *Fauſtus*, as he calls him, publiſhed *Alexandri Doctrinale cum Petri Hiſpani Tractatibus*, *A. D.* 1442; but this and ſome other books mentioned by writers on this ſubject, are never ſaid to be extant in any particular place, to be conſulted on occaſion; and therefore, their titles and dates are not ſo much to be relied upon; but another date, which, tho' not ſo old, is more authentic, and to be found in the above-quoted book of *Lambecius* p. 989; where he ſays, he brought from *Inſpruck*, amongſt other

other choice volumes, and placed in the imperial library at *Vienna*, a pſalter printed upon parchment, with this inſcription at the end; *præſens Pſalmorum Codex venuſtate Capitalium decoratus, rubricationibuſque ſufficienter diſtinctus, adinventione artificioſâ imprimendi & characterizandi, abſque calami ullâ exaratione ſic effigiatus, & ad euſebiam Dei induſtriè eſt conſummatus per* Joannem Fuſt *Civem Moguntinum*, & Petrum Schoeffer *de Gernſzheim, Anno Domini milleſimo* CCCCLVII *in Vigilia Aſſumptionis:* From this time there are conſtant remains of the induſtry of theſe men, and he could mention more books printed by them, than the *Durandus* in the library of *Baſil* in *Switzerland*, printed (as a gentleman who ſaw it told him) *A. D.* 1458, *Joannes Joannenſis's Catholicon* (in her majeſty's and the lord biſhop of *Norwich*'s libraries) printed 1460; the *Latin* bible of 1462, ſtill extant in the *French* king's library, and in divers monaſteries beyond ſea, and perhaps in *England*; *Tully's Offices* printed both in 1465 and 1466 (if both theſe are not the ſame edition, the laſt ſheet or leaf having been compoſed a-freſh) and ſo on, till *Schoeffer* work'd for himſelf after the death of *Fuſt*, and *Schoeffer*'s poſterity after him.

Upon the firſt diſcovery of the art by *Fuſt* at *Paris*, or at his firſt ſettlement or public profeſſion thereof at *Mentz*, it quickly ſpread over the beſt part of *Europe*; and from theſe places, and from books or parts of books, where, or wherein ſuch ſorts of letter were uſed, the printers do ſtill call their letter, *Italic*, *Roman*, *Engliſh*, *Auſtin*, *Canon*, *Pica*, *Primer*, *Brevier*, &c. and printing was commonly uſed in other countries, before it was known in *England* (notwithſtanding what ſome writers affirm to the contrary) the firſt book that we pretend to have been printed here in *England* being *Hierom*, or rather *Ruſinus* on the creed, printed at *Oxford*, *A. D.* 1468.

To prove this in ſome meaſure (not to mention the progreſs of printing in other countries) our author inſtances in *Italy*, and particularly *Rome*; here, not to inſiſt on the large catalogue of printed books deſcribed in an epiſtle to pope *Xyſtus* IV. publiſh'd at the beginning of the 5th tome of the bible, printed with *Lyra's* commentaries at *Rome*, *A. D.* 1472, and tranſcribed by *Boxhornius*; our author only relates the ſubſtance of what he met with in *Bernard Montfaucon's Diarium Italicum*, tome I. p. 255, 256; *viz. that* Joannes Alerienſis, *in a flattering epiſtle to Pope* Paul II. (who was elected *A. D.* 1464) *congratulates him, becauſe printing was firſt uſed at* Rome *under his Pontificate*; which if meant of the very firſt practice of the art at *Rome*, and

not of an eſtabliſhed imprimery, ſeems to be falſe; becauſe, this learned Monk, in the ſame place, ſays, *He ſaw a* Lactantius *in the* Muſæum, *or ſtudy of M.* de la Thuilliere, *which has theſe words at the end*; *Lactantii Firmiani Inſtitutiones cuſæ in venerabili Monaſterio Sublacenſi*, Anno 1461, *antepenultimâ Octobris*; now, unleſs a man will ſuppoſe printing to be invented in this monaſtery, he muſt believe it to be brought hither from *Rome*, which is but about 20 miles diſtance from it; and the ſame author ſays, that *Floravantes Martinellus* in his *Roma Sacra, affirms that printing was practiſed at* Rome *in the palace of the* Maxime, A. D. 1455, *under Pope* Nicholaus V. *by* Conrad Sweynheim *and* Arnold Pannartz, *who were both* Germans, *and continued printers there for ſeveral years after.*

The cuſtom of putting the dates of printed books at the end of them, was taken up in imitation of divers manuſcripts of the middle and latter ages (for our author never ſaw nor heard of any ancient manuſcript in capital letters, either *Greek* or *Latin*, which has a profeſſed date written in the firſt hand) but here one ought to be cautious, leſt he be led into an error; for, ſeveral manuſcripts at the end have a date, which may be underſtood by ſome of the time, when thoſe individual copies were written; whereas, they only notify the time, when the author finiſhed his work; and ſome of theſe dates having been printed from the manuſcripts, have deceived ſeveral curious men; for example the firſt edition of *Lyndwood*, *Paulus á Sancta Maria*, and others he could name; beſides, ſome dates in ancient printed books, not being corrected, are falſe; ſuch was a book printed in the beginning of the 16th century, in the library belonging to the *Aſhmolæan Muſæum* at *Oxford*, which thus pretends to 400 500 years of age; a *Julius Hyginus* was once ſhewn him by Mr. *Millington* a bookſeller, printed at *Paris*, as there ſet down, *Anno Domini* MCCCCXII inſtead of MCCCCCXII for, the printer is mentioned, as then living in *l'origine de l'imprimerie de* Paris; our author had a book, wherein among other tracts, is one of an old print, at the end of which there ſeems to be ſuch a miſtake, tho' not ſo eaſily rectified as the former; the words are theſe, *explicit Opuſculum* Enee Sylvii *duobus Amantibus in Civitate Leydenſi Anno Domini milleſimo* CCCC *quadrageſimo tertio* LEIEN; now, tho' *Leyden* ſeem to be the place where it was printed, yet 1443 cannot be the time; for, juſt before, *Sylvius* himſelf ſays, *vale, ex* Vienna *quinto Nonas Julias Mo* CCCC *quadrageſimo quarto*; *Sylvius* was elected Pope by the name of *Pius* I. *A. D.* 1458, and died

A. D.

A. D. 1464; now, it may ſeem probable, that if this tract was printed after his election, as ſuppoſe *A. D.* 1463, or even after his deceaſe, his papal dignity might have been remembered; if it be judged to have been printed before his election, our author knows none that will allow of printing at *Leyden*, or even at *Lyons*, ſo very early.

One objection may be urged againſt what is ſaid of *Coſter*'s, or the old printed books above-mentioned, being printed upon paper about *A. D.* 1430, or ſoon after; for, ſome authors are of opinion, that paper made of linen-rags was firſt made at *Baſil*, by ſome *Greeks*, who fled from their country after the ſaccage of *Conſtantinople*, *A. D.* 1452, in imitation of the cotton-paper, commonly uſed in the *Levant*; but this can have no force, our paper being much older; for our author had a piece, the writing on which ſeems to be about 350 years old, and agrees very well with a charter, which he had ſeen of *Thomas Beauchamp*, earl of *Warwick*, bearing date *A. D.* 1356, and the 32d of *Edward* the III. in the archives of the library belonging to the R. R. Dean and Chapter of *Canterbury*; he alſo ſaw an inventory of the goods of *Henry*, prior of *Chriſt*'s church there, taken upon his deceaſe, in the 20th year of King *Edward* the III. which was written upon paper; in the *Cottonian* library, he obſerved ſeveral writings upon our paper, in the time of moſt of our kings and queens, as high as the 15th of king *Edward* the III. and he does not doubt, but there are others more ancient in the ſame place; but, in the eaſt, the uſe of cotton-paper is much more ancient, and our author had ſeen in the *Bodleian* library an *Arabic* manuſcript, (amongſt thoſe the univerſity bought of Dr. *Huntingdon*) written in the 427th year of the *Hegira*, i. e. *A. D.* 1049; and others in the ſame place, without dates, ſeem to be older.

Tho' the invention of the rolling-preſs is commonly aſcribed to *Lipſius*, yet it ſeems older than his time, from a printed book in the *Bodleian* library, placed LAUD. D. 138, which is a *Miſſale ſecundum uſum Eccleſiæ Herbipolenſis*, i. e. *Wurtzburg* in *Germany*; *Rhodolphus*, archbiſhop of that church, ſets forth in an inſtrument at the beginning of the book, the reaſons why he cauſed this miſſal to be publiſhed; which inſtrument bears date the 8th of *November* 1481, by which time he ordered all the copies to be finiſhed by *Jorius Ryſer* his printer, who ſeems to have done ſo, ſince his name, and this year 1481 is written at the end of the book; inſtead of a ſeal to this inſtrument, there is an engraven print, being the arms of the *See* ſupported by two

angels, and St. *Kilian* its firſt biſhop and protector behind; as alſo this prelate's own arms, with thoſe of the *See* in another eſcutcheon, and a very fine mantling; this is exceedingly well engrav'd, conſidering the time, and equals the performances of ſome of our beſt workmen at preſent; the evident marks of preſſure by the plate, with ſome touches of ink at the edges, the roughneſs of the print, and other circumſtances concurring, ſhew that it muſt needs be wrought off at the rolling-preſs; and divers very knowing and curious gentlemen, ſeveral printers, engravers and others, conſtantly working at the rolling-preſs, all concurr'd at different times, that it was not only extremely well engraven (and this before *Albert Durer*'s time) but that it was certainly pull'd from the rolling-preſs and could be done no other way; and that this print was not done after that time, appears from ſeveral notes written here and there in the book; one of them ſpecifies that *William Kewſth*, vicar of St. *Bartholemew*'s church in *Wurtzburg*, bought this book in the ſame year 1481, paying 18 *Florins* for the parchment, printing, rubrication, illumination and binding; by another it appears, that he gave it to his church for ever; and by ſome others, that it remain'd there during the times of his ſeveral ſucceſſors, till the laſt age, when the *Swedes* under *Guſtavus Adolphus*, plunder'd the church, and carried the book away.

Worms *obſerv'd in* Sheep's Livers *and* Paſture-grounds; *by M.* Leewenhoeck. Phil. Tranſ. N° 289. p. 1522.

IN the ſummer of the year 1702, we had not rain enough to cover even the loweſt parts of the meadows adjacent to *Delft*; inſomuch, that none of the ſheep of that year drank of the waters that us'd to ſtagnate on the ſaid meadows; which when it happens, produces (according to the opinion of our butchers) a certain ſort of worms call'd *Bottiens* in their livers; notwithſtanding which M. *Leewenhoeck* was inform'd, that ſome of the ſheep of thoſe paſtures had their livers infected with ſuch like worms, which made him conjecture, that the above-mention'd diſtemper in ſheep's livers, muſt proceed from ſome other cauſe, than their drinking the ſaid waters; therefore, caus'd a butcher (who was proprietor of one of theſe meadows, and who had alſo inform'd him, that the ſheep he turn'd into that ground were mightily peſter'd with worms in their livers) to cut two pieces of green ſod from thence, to the end, that M. *Leewenhoeck* might try, whether he

he could find any ſuch worms therein; this land he told M. *Leewenhoeck* was ſo high, that it was never entirely under water in winter time; but the ditches about it were ſo full, that they were in a manner, level with the land, and ſome of the lowermoſt parts of the ſame, when it rain'd much, were cover'd in a ſhort time; M. *Leewenhoeck* examined very carefully thoſe two pieces of earth, but he could find no *Animalcula* therein, any way reſembling the worms in the ſheep's livers; from hence he infers, that the *Animalcula* not only found in ſheep's, but in cow's livers too, muſt not be ſought for in thoſe waters that ſtagnate upon the land, but in the land itſelf; which being thoroughly wet or ſoak'd, they aſcend to its ſuperficies, becauſe the common water not being natural to them, they cannot live therein; and thus lurking in the graſs, they are ſwallow'd by the cows and ſheep, and ſuch as eſcape their teeth, are convey'd into their ſtomachs and bowels, and inſinuate themſelves even into the liver: M. *Leewenhoeck* was often told, that the cattle which feed in *Siltagtig* grounds are free from this diſeaſe of worms; but being inform'd at the ſame time, that the ſaid kind of ground is very low, and lies under water the moſt part of the winter, he gave the following reaſons; why kine and ſheep that feed in high clay-grounds are troubled with worms in their livers, and thoſe in low grounds not; *viz.* only becauſe the low grounds lie all winter under water; for tho' ſuch like worms may be found in ſome of the low lands, yet as ſoon as they are overwhelm'd with water, thoſe worms abhorring the water, die immediately; to confirm this reaſoning, he took a glaſs-tube, which was an inch wide at the upper extremity, and above a foot long, into which he put a little piece of the above-mention'd earth, near five inches long, but ſo narrow, and the graſs about it clipp'd ſo cloſe, that it would eaſily enter the tube without preſſing; and then he pour'd upon it boil'd water, which had ſtood till it was cold; preſently after he perceiv'd, that ſeveral very ſmall and long white worms came out of the earth, which reaching and incurvating their bodies, leiſurely ſubſided to the bottom of the tube, none of them being able to emerge to the ſurface; whence he concluded, that they could not live in the water; and in effect, after they had lain 24 hours in the bottom of the glaſs, he found they were all dead; it appear'd to M. *Leewenhoeck*, that theſe white worms were of ſeveral ſizes, and that they could not be the offspring of our common worms, becauſe they were much longer in proportion to their bigneſs;

bigneſs; he alſo ſaw a common worm creeping out of the aboveſaid earth, which leiſurely ſubſided, and remain'd at the bottom of the tube, with little or no motion, and next day it was dead; ſome of thoſe ſmall *Animalcula* that came out of the earth, and ſwam about the water, were ſo exceeding ſmall, that he could not perceive what figure they were of, tho' he had view'd them very carefully and very frequently; nay, tho' he had ſhifted the earth and water three times: Now, that theſe *Animalcula* may be call'd water-worms, tho' they are found in the drieſt parts of the earth, appears from their living ſo well in the tube fill'd with water; in which having obſerv'd them day after day, he found no difference, only that they were increas'd in number; and beſides, he has met with ſeveral of them in common water: In theſe obſervations he diſcover'd a few particles of ſand mix'd with clay, the ſides of which appear'd, as if they had been broken or grated off from ſtones, and ſome of them were ſo very ſmall, that above 1000 of them together did not exceed the magnitude of a ſingle grain of common ſcowering ſand.

At another time M. *Leewenhoeck* went into one of the meadows near *Delft*, which conſiſted of a good clay ſoil, and lay as high as any about town; he dug out a bit, about the bigneſs of a crown, out of the ſaid ſoil, which was cover'd with clover-graſs, ſhort and fine, imagining, that he ſhould find in the top of it ſome *Animalcula*, becauſe he had formerly found in the rotten wood of a willow-tree, and in another rotten plank that had lain in the open air, ſome of theſe *Animalcula*, which are uſually found in water; he clipp'd away the graſs from the bit of clay, and put the top of it into a clean glaſs-tube, as big as a child's finger, and he pour'd thereon boil'd rain-water, after it was cold; and ſhaking the earth and water well together, the water was ſo muddy, that he could perceive none of the *Animalcula* therein; but after it had ſtood about half an hour in the tube, he could ſee ſeveral *Animalcula* creeping up the ſides of it, and others ſwimming about the water; after this water had ſtood ſeveral hours, and acquir'd a little more clearneſs, he ſaw two particular *Animalcula*, that in ſhape very nearly reſembled thoſe that exert little wheels out of their bodies, only that inſtead of ſuch wheels, they protruded a horny part, which they ſometimes drew in, and then thruſt out again; there was alſo one *Animalculum* that put out two wheels, and juſt by, he perceiv'd two other ſorts of *Animalcula*, but he immediately loſt ſight of them again; from whence he con-

concluded, that ſo much water was not natural to them, and that therefore they died; and after that the water had ſtood three days upon the clay, he ſaw ſeveral *Animalcula*, that were four times as long and as thick, clinging to the ſides of the tube, without any motion, tho' they ſtirr'd about briſkly at firſt.

M. *Leewenhoeck* took another glaſs-tube, and putting therein a little of the ſame clay, which he handled very tenderly, he pour'd upon it ſome of the boil'd water as before, without ſhaking it at all, that the *Animalcula* might emerge the better; and after an hour's time, he ſaw about 20 *Animalcula* ſwimming (whereas, he could perceive none in the firſt) and one of them protruded wheels out of its body: Now it will appear ſurpriſing to ſome, that theſe *Animalcula*, which uſually and naturally ſwim in water, ſhould be found in earth that has not been moiſten'd by rain or otherwiſe for ſeveral weeks; but M. *Leewenhoeck* has often found by experience, that ſeveral ſorts of very minute *Animalcula* are to be met with in rain-water, and eſpecially in the gutters on the tops of houſes; for he has taken ſome of the ſlime or dirt of thoſe gutters, after they have been dry above a year, and diluted the ſame in boil'd water, after it has been cold, whereupon, he ſaw ſeveral *Animalcula* ſwimming; and ſome of them being folded up, almoſt in a globular figure, extended their bodies leiſurely, and then they ſwam about in the water.

If it be objected, how comes it to paſs, that theſe *Animalcula*, that are merely aquatic, ſhould be found on the land ſeveral roods diſtant from any ditch? To which M. *Leewenhoeck* anſwers, by ſuppoſing that this happens after the following manner; we often find, that in a ſtorm, the water has been ſo furiouſly driven againſt the ſides of the ditches, and the parts of ſuch water have been ſo minutely divided, that not only ſeveral of its ſmaller particles have been carried a great way into the land by a ſtrong wind, but ſome of them have alſo been exhal'd, even into the clouds; and he was confirm'd in this opinion, by the following inſtance; at one time he ſtood to obſerve with what force, and at how great a diſtance, a bleacher caſts water with his ſcoop out of a ditch, upon his linen ſpread over a meadow, whereby ſeveral of the parts of the water were ſo divided, that they never fell to the earth, but were exhal'd into the clouds: In the ſaid ſmall particles of water are convey'd the above-mention'd *Animalcula* far up into the land, and when the ground becomes dry, they contract

tract themſelves into an oval figure, and the pores of their ſkin are ſo well clos'd, that they do not perſpire at all, whereby they preſerve themſelves, till it rains; upon which they open their bodies, and enjoy the moiſture.

Obſervations on the great Storm Nov. 26. 1703; *by Mr.* William Derham. Phil. Tranſ. N° 289. p. 1530.

TO look back to the preceeding ſeaſons of this year, *April*, *May*, *June* and *July* were wet months in the ſouthern parts of *England*; particularly, in *May* there fell more rain than in any month of any year ſince 1696; and tho' *July* had conſiderable intermiſſions, yet on the 28th and 29th there fell violent ſhowers of rain; and the news papers gave an account of great rains that month from divers places of *Europe*; but the north of *England* (which alſo eſcap'd the violence of the ſtorm) was not ſo remarkably wet in any of thoſe months; at leaſt, not in that great proportion, more than in the ſouthern parts, as uſually they are; particularly *July* was a dry month with them, there being no more than 3, 65 *l.* of rain fell thro' Mr. *Townley*'s tunnel of the ſame diameter with Mr. *Derham*'s; *September* with us was a wet month, eſpecially the latter part thereof; there fell of rain in that month 14, 86 *l.* *October* and *November*, tho' they were not remarkably wet, yet had been open warm months for the moſt part; at *Upminſter* Mr. *Derham*'s thermometer, whoſe freezing point was about 84, had been very ſeldom below 100 all that winter, and eſpecially in *November*.

Mr. *Derham* has given this account of the proceeding diſpoſition of the year, particularly as to wet and warmth; becauſe, he is of opinion, that theſe had a great influence on the following ſtorm; not only in cauſing a repletion of vapours in the atmoſphere, but alſo in raiſing ſuch nitro-ſulphureous or other heterogeneous matter, which when mix'd together might make a ſort of exploſion, like fir'd gun-powder, in the atmoſphere; from which exploſion, Mr. *Derham* judged, that thoſe coruſcations or flaſhes in the ſtorm proceeded, which moſt people, as well as himſelf, had obſerv'd, and which ſome ſuppos'd to be lightning.

On *Thurſday Nov.* the 25th, in the morning there was a ſmall rain, the winds were high in the afternoon, being at S. *b.* E. and S; in the evening there was lightning; and between 9 and 10 o'clock at night, there was a violent but ſhort ſtorm of wind, and much rain at *Upminſter*, and a great deal of hail in

in ſome other places; next morning the wind was S. S. W. and high all day; and ſo it continu'd till about 12 at night, when the ſtorm awak'd Mr. *Derham*, which gradually increas'd till near three that morning; and from thence till ſeven it continu'd with the greateſt violence, and then it began to abate ſlowly, and the mercury roſe ſwiftly; at half an hour after 12, he found the barometer at 28, 72, where it continu'd till about ſix next morning; ſo that it was got to 82 about eight o'clock, as in the following table.

How the wind ſate during the ſtorm, he could not poſitively ſay, it being exceeding dark all the while, and his vane blown down; but he ſuppoſes it to have blown about S. W. by S; or nearer to the S. in the beginning, and to have veer'd about towards the W. about the latter end of the ſtorm, as far as W. S. W. the degrees of the wind's ſtrength not being meaſurable but by gueſs, he determin'd thus, with reſpect to other ſtorms; on *Feb.* 7, $169\frac{8}{9}$ there was a terrible ſtorm that did much damage; this he reckons 10 degrees, the wind being then W. N. W; another remarkable ſtorm was *Feb.* 3, $170\frac{1}{2}$, at which time there was the greateſt deſcent of the mercury ever known; this he reckons nine degrees; but this in *November*, he computes at leaſt at 15 degrees: As to *November* 17th (on which Mr. *Townley* mentions there was a violent ſtorm in *Oxfordſhire*) it was a ſtormy afternoon at *Upminſter*, accompanied with rain, but not violent, nor was the mercury very low; *November* the 11th and 12th had higher winds and more rain, and the mercury was lower than even in the ſtorm of *November* 26th: Mr. *Derham* had accounts of the violence of this ſtorm at *Norwich*, *Beccles*, *Sudbury*, *Colcheſter*, *Rochford*, and ſeveral other intermediate places.

A Table ſhewing the Height of the Mercury in the Barometer, at *Townley* and *Upminſter*, before, in, and after the Storm.

Townley			Upminſter		
Day	*Hour*	*Height of Mer.*	*Day*	*Hour*	*Height of Mer.*
Nov.	7	28,98	*Nov.*	8	29,56
25	3	,64	25	12	,39
	9 ½	,61		9	,14
26	7	,80	26	8	,33
	3	,70		12	,28
	9 ½	,47		9	,10
				12½	28,72
27	7	,50	27	7 ½	,82
	3	,81		12	29,31
	9 ½	,95		9	,42
28	7	29,34	28	8	,65
	3	,62		12	,83
	9	,84		9	30,07
29	7	,88	29	8	,25

Mr. *Derham* receiv'd an account from a clergyman at *Lewes* in *Suſſex*, not only that the ſtorm had made great deſolation thereabouts, but that a phyſician, travelling ſoon after the ſtorm to *Tiſehyrſt*, about 20 miles from *Lewes*, and as many from the ſea, had pluck'd ſome tops of hedges, and chewing them he found them ſalt; and ſome at *Lewes* taſting grapes that were ſtill on the vines, they had alſo the ſame reliſh; the graſs on the downs in his pariſh was ſo ſalt, that the ſheep would not feed in the morning, till hunger compell'd them; and afterwards they drank plentifully, as the ſhepherds reported; this the clergyman attributed to ſaline particles driven from the ſea; he alſo heard, that people about *Portſmouth* had been much annoy'd with ſulphureous fumes, complaining they were almoſt ſuffocated therewith.

One Mr. *Fuller* gives an account that the country people in *Suſſex*, tho' about 10 miles off the ſea in a direct line, could ſcarcely be perſuaded, but that the ſea-water was blown thus far; or that, during the ſtorm, the rain was ſalt, for all the twigs of the trees the following day were white, and taſted very ſalt, as he was inform'd; and that not only upon the hill where he liv'd facing the ſea, but in all other places within 14 or 15 miles of the ſea, as well in the valleys, between which

and the ſea are ſeveral high hills, as alſo on the hills themſelves.

Obſervations on the ſame Storm; *by M.* Leewenhoeck. Phil. Tranſ. N° 289. p. 1535.

ON the 8th of *December* 1703 N. S. we had a dreadful ſtorm from the S. W. inſomuch, that the water mixing with ſmall particles of chalk and ſtone, was ſo daſh'd againſt the glaſs windows, that ſeveral of them were darken'd thereby; the lower windows of M. *Leewenhoeck*'s houſe, notwithſtanding they look'd to the N. E. and ſo ſtood from the wind, were ſo cover'd with the particles of the water, which the whirl-wind caſt againſt them, that in leſs than half an hour's time they loſt moſt of their tranſparency; ſuppoſing this might be ſea-water, he view'd the particles with his microſcope, and he found they had the figure of our common ſalt; as to the upper windows, where the rain had beat againſt them, there was little or no ſalt to be found ſticking on them; during the ſaid ſtorm, and about eight o'clock in the morning, caſting his eye on his barometer, he obſerv'd, that he had never ſeen the mercury ſtand ſo low; but half an hour after, it began to riſe, tho' the ſtorm had not been at all abated, at leaſt to any appearance; from whence he concluded, that the ſtorm would not laſt long, which accordingly happen'd; ſome ſuppos'd that the ſcattering of this ſalt water would do a great deal of harm to the fruits of the earth; but M. *Leewenhoeck* was of opinion that a little ſalt ſpread over the ſurface of the earth, eſpecially where it is heavy clay-ground, renders it fruitful; and ſo it would be, if ſea-ſand were made uſe of to the ſame purpoſe.

The Figures *of* Sand, *by the Same.* Phil. Tranſ. N° 289. p. 1537.

M. *Leewenhoeck* formerly affirm'd of ſand, that one cannot find in any quantity whatſoever two particles thereof, that are entirely ſimilar; and tho' perhaps, in their firſt configuration, they might have been ſo, yet at preſent, they are exceeding different; eſpecially, the ſand we make uſe of, is obnoxious to ſuch great alterations, that it would be a wonder, if even in its minuteſt particles, of which there may be 1000 in one ſmall grain, there ſhould be an exact ſimilitude; for let us conclude that our common ſand, of which one grain differs from another in pellucidity, was at firſt form'd with

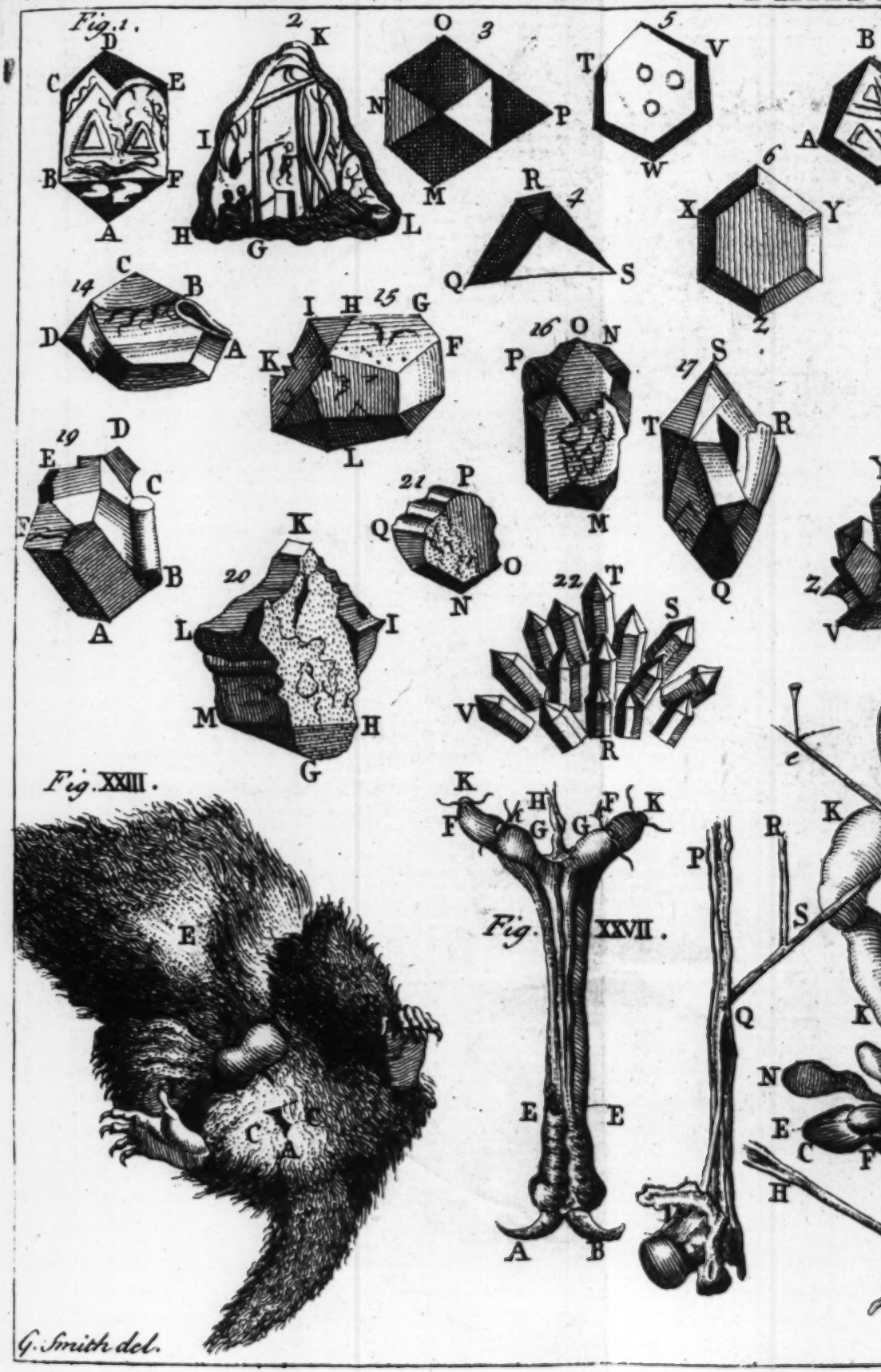
mooth ſides and ſharp points, both theſe are ſo rubbed the one againſt the other, that ſeveral ſmall pits or holes may be perceived therein, whereby they loſe their firſt figure; and who can conceive what changes thoſe particles of ſand undergo, that lie next the ſuperficies of the terreſtrial globe; eſpecially, ſuch as lie at ſome depth under a ſtony ground, where laden waggons often paſs; for theſe particles of ſand, by frequent compreſſions and colliſions, indent holes in each others ſides, and break off their ſharp points, or angles; not to mention, what alterations are made in theſe ſmall bodies by ſtorms, thunder, earthquakes, &c.

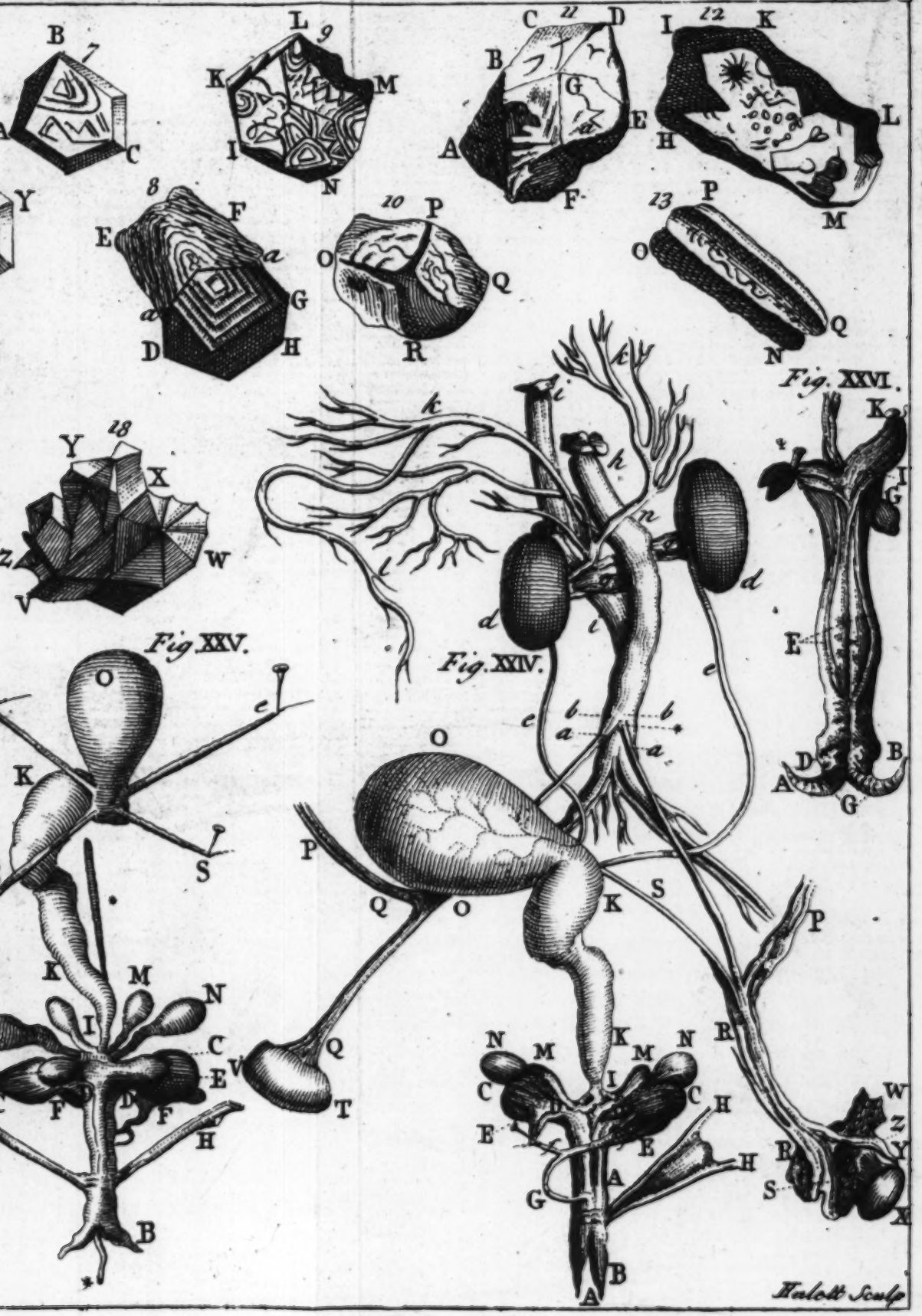
M. *Leewenhoeck* got ſome ſhining ſand, which tho' very fine was not tranſparent; its luſtre being entirely occaſioned by the reflection of the light from its poliſhed ſides; ſeveral particles of the ſaid ſand, which were much bigger than the reſt, reflected no light, tho' they ſeemed ſmooth to the naked eye; from whence he concluded, that they had loſt their glittering by the frequent friction of their ſides againſt each other; when he had viewed ſeveral grains of the above ſand with his microſcope, he was ſurpriz'd to ſee, that a great number of them were hexangular, even after ſifting the fineſt from the coarſeſt; nor could he obſerve, that any of the ſands were ſimilar; he viewed the ſaid ſand ſeveral times with great attention, ſuppoſing, that by ſome earthquake or other, it might have been thrown up from the place where it had lain at reſt, to the ſuperficies of the earth; and ſeveral grains appeared to him to have preſerved their original ſhape and figure; for they had received little or no damage, eſpecially the ſmall ones; ſeveral of which had ſuch points and ſides, that no poliſhed diamond could equal their beauty: He infuſed ſome of this ſand in *Aqua fortis*, to try whether it would diſſolve them, or deprive them of their ſhining quality; and tho' it lay in the ſaid water ſeveral days, he could not perceive any alteration therein; moreover he tried the ſaid ſand with ſo briſk a fire as was capable of melting ſilver, and yet it did not affect either its figure or luſtre.

Plate IX. Fig. 1. A B C D E F repreſents an hexangular grain of ſand, (being exceeding ſmall, and not unlike white ſcouring ſand) that was as bright and ſhining as any poliſhed metal; and the triangular figures which appeared thereon, were as bright as the reſt of the body, which occaſioned a very agreeable ſight.

Before one of his glaſſes he placed another grain of ſand, leſs than the former, but it was flat, and he ſuppoſed that it was not a 16th part ſo big as a coarſe grain picked out of our common white ſand; and this was a ſurprizing ſight; in the ſaid ſand, repre-




Fig. 1.
D
C
E
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Z
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14
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D
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19
D
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21
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Q
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I
M
H
G
22
T
S
V
R
Z
V
Fig. XXIII.
K
H
F
K
F
G
G
Fig. XXVII.
E
E
A
B
E
C
A
c
K
R
P
S
Q
K
N
E
C
F
H
G. Smith del.


Fig. XXIV.
Fig. XXV.
Fig. XXVI.
Halett Sculp

repreſented by GHIKL Fig. 2. you may ſee not only as it were a ruined temple, but in its angle GHI appear two images of a human ſhape, kneeling and extending their arms towards an altar, that ſeems to ſtand at a ſmall diſtance from them; this was ſtill the more agreeable, becauſe it was as bright as any poliſhed ſteel.

Fig. 3. MNOP repreſents (as near as could be traced) another ſmall hexangular grain of ſand, with two ſharp points like pyramids, and each ſide that compoſed the ſaid points were very ſmooth and ſhining; M. *Leewenhoeck* has ſeen ſeveral ſuch grains of ſand, which had on each ſide a ſmooth, ſhining, and oblique ſuperficies; inſomuch, that upon one ſingle grain he has reckoned 24 ſuch poliſhed ſides or faces; he has alſo obſerved ſeveral ſmall grains of ſand, that, inſtead of terminating their ſix ſides in a ſharp point, ended ſometimes in a triangle, quadrangle, and even in a pentagonal or hexangular ſhining flatneſs; he obſerved ſeveral three-ſided grains, of which ſome were regular triangles, which were very ſhining and very thin, and others were thicker, as repreſented in QRS Fig. 4.

There were other grains of ſand that were complete hexangles, the flat ſides of which appeared like a ſteel looking-glaſs in a frame, and in ſome of them were little holes, which ſeemed likewiſe hexangular; whence he concluded, that ſuch a hole was made from the preſſure of another ſand of the like figure, as repreſented in Fig. 5. TVW; when he viewed any of theſe ſands ſideways, each of the ſix ſides, which in the figure appear like a frame or border, ſeemed to be a poliſh'd looking-glaſs.

Fig. 6. XYZ does alſo repreſent an hexangular ſand, oppoſed to the ſight a little ſideways, whereby the reflexion is not ſo full and large, as if the flat ſide were placed directly before the eye; but then, it came from the two ſides, which repreſent a part of the frame, and are ſhewn in this figure by X; now, when the hinder part of ſuch a ſand is brought before the ſight, he obſerv'd that it had the ſame figure; and that then, that part of it which ſhould be repreſented as a dark circle of the ſhining ſand, conſiſted of 12 bright, oval, flat ſuperficies.

Fig. 7. ABC repreſents another hexangular ſand, whoſe bright ſuperficies or area was of a different make from its circumference; for, there appeared in the middle of them ſeveral triangular figures, which tho' ſomewhat raiſed and imboſſed, were very bright, and withal afforded a pleaſant ſight; and tho' the cir-

circumference in this poſition appeared very dark, yet its ſides, when expoſed to view, were no leſs bright and ſhining.

Fig. 8. DEFGH repreſents another grain of ſand, with its protuberant parts and their reſpective ſides: M. *Leewenhoeck* turned the oppoſite ſide of the ſaid ſand to his glaſs, whereby he diſcovered its ſeveral ſhining angles, as repreſented in Fig 9. IKLM; he placed, before his glaſs, another ſmall ſhining grain of ſand, which appeared as in Fig. 10. OPQR, ſeveral of whoſe ſides were unblemiſhed; and ſhould he enter upon a ſtrict examination of every one of the grains of ſand, he does not doubt, but he would diſcover each of them to be of a different ſize and figure, beſides ſeveral other particularities, which might be peculiar to each; as the great rent or breach, which is repreſented in Fig. 8. by *aa*; he alſo obſerved, that this ſhining ſand weigh'd twice as heavy as our common ſcouring ſand; now, upon his taking ſome of the pellucid or tranſparent ſand (which did not ſhine, becauſe it reflected no light) he obſerved that the ſides and angles of each grain were freer from ſcars and blemiſhes, than moſt others he had hitherto conſider'd; from whence he concluded, that ſuch ſand had not lain long near the ſurface of the earth.

He placed one of theſe ſands before a microſcope, ſo as to have a full view of three of the four oblique ſides, as repreſented in Fig. 11. by ABCDEFG; one of the flat ſides by BCDG; another by DEAG, which had a ſtreak or ſcratch therein, ſuppoſed to be done by the preſſure of another grain of ſand upon it; and the third flat ſide by BG*ab*.

Fig. 12. HIKLM repreſents this tranſparent ſand in its full length, together with the ſtreaks or little holes therein, which M. *Leewenhoeck* firmly concluded to be occaſioned by the colliſion of other ſands; he likewiſe obſerved ſome, but very few, ſands that were long and ſlender, which appeared thro' a common microſcope no bigger than a ſingle hair of a perſon's beard does to the naked eye.

M. *Leewenhoeck* took ſeveral of the ſhining ſands and broke them to pieces; and then viewing the broken pieces thro' a microſcope, he obſerved that ſeveral of thoſe ſmall particles, tho' 1000 times leſs than a grain of common ſand, had a luſtre when the light fell upon them; and that ſeveral ſuch particles, and ſome that were larger, if view'd againſt the light, repreſented a fine blooming red; but ſome of them were ſo but in part; from whence he concluded, that that part which was not red was thicker

than

than the reſt, and ſo did not admit of light thro' it; amongſt theſe ſmall broken pieces of ſand, he obſerved ſome that had ſix ſides, and others that were triangular; all which are to be conſidered as common ſand; he took one of the abovementioned long ſlender ſands, which he judged to be one of the thickeſt, and placing it before a microſcope, it appeared as repreſented in N O P Q. Fig. 13; wherein may be diſtinctly perceived four flat ſides; he alſo obſerved in ſeveral ſands, that their bodies conſiſted of unſpeakably thin ſcales or ſcaly particles: Among theſe ſhining ſands he diſcover'd others that had no luſtre at all, nor any of their particles that were broken to pieces; only it appeared to be a dark red matter; and in other broken particles there was not only a red matter, but even a 100 ſhining particles, all proceeding from one grain of ſand; he had alſo ſeen ſome ſands, that in the middle of their ſhining ſides repreſented ſmall figures, that gave no luſtre; but upon viewing them more narrowly, he found it was a red matter, incorporated as it were, in the ſand; ſeveral ſands of the coarſeſt ſort, which he had placed before a microſcope, ſeemed to repreſent an agreeable rock of ſtone, and another a deep cavern; theſe laſt ſands were not as M. *Leewenhoeck* ſuppoſes, ſo ſhaped from the beginning, but theſe cavities and protuberances were owing to various chances and accidents; as by the colliſion of other particles of ſand bigger than theſe, which likewiſe in their turns were again broken by other bodies of a larger ſize, ſuch as pebble-ſtones, *&c.* he divided ſome grains of ſand in two, and therein he diſcover'd figures of triangles.

Soon after the cathedral church at *Utrecht* was almoſt ruin'd by a dreadful ſtorm in 1704, M. *Leewenhoeck* took ſome of the red ſtone (whereof ſeveral of the pedeſtals, as alſo ſome tomb-ſtones were compos'd) and viewing it with his microſcope; that ſort of ſtone then appear'd to him to conſiſt for the moſt part of large and tranſparent grains of ſand; and that the redneſs of the ſtone was only caus'd by a certain red matter, which had produced ſuch a continuity or adheſion in the maſs of the ſand, as to be able to conſolidate it into a red ſtone; being of this opinion, he gently ſeparated ſeveral ſand-particles from the little piece of red ſtone; and becauſe the red matter which adher'd to ſome of the ſands more than to others, hinder'd him from taking a diſtinct and clear view of each particular grain, he put ſome of them into *Aqua-fortis*, to try whether that would diſſolve the red matter, and reſtore its luſtre to the ſand; but to no purpoſe; for that *Menſtruum* could not ſeparate them; then he took

ſeveral

ſeveral of thoſe particles of ſand, that were leaſt ſurrounded with ſuch red matter, and placing them before the microſcope, he obſerved that ſome of them had 10 or more ſharp points or protuberances, ſo neatly and regularly faſhion'd, that no poliſh'd diamond could out-do them; he ſet one of the largeſt grains of ſand before his glaſs, and therein he could perceive, and that too in a very ſmall compaſs, ſeven neat prominent points (exceeding each other in length and bigneſs) iſſuing out from very ſmooth ſides; and he judged that one ſuch ſand was furniſh'd with above 100 flat ſides, which were very ſmooth, and conſequently very ſhining, tho' one could not diſcover with the naked eye any diſcernible brightneſs; the reaſon of which he ſuppoſes to be, that this ſand being partly tranſparent, admitted the light thro' its pores, but did not reflect it back like the ſhining ſands; upon his viewing never ſo many of theſe ſands, he found each of a different figure; and when he pick'd any out that were ſomewhat oblong, he ſeldom fail'd to diſcover at their extremities a four or five ſided obtuſe point, ſo neat and regular, as if it had been poliſh'd; upon breaking to pieces ſeveral grains of ſand upon a clean glaſs, he found that they were not near ſo ſtrong as the ſhining ſand; and having placed the ſmall particles of ſuch a broken grain of ſand before his microſcope, ſome of them appear'd like whole ſands with their ſides and angles entire, all which was a very agreeable ſight.

Fig. 14. A B C D E repreſents thro' a microſcope, one of the above-mention'd grains of ſand, ſeveral of which together compoſe the red ſtone; A B C D ſhews the points which are much more plainly ſeen, than ſeveral others that cannot be diſtinguiſh'd, becauſe of their different poſitions.

Fig. 15. ſhews another ſand, which likewiſe has ſeveral points, tho' not ſo obvious as the former; becauſe they do not ſtand ſo far outwards.

Fig. 16. M N O P repreſents the laſt mention'd ſand in another poſition.

Fig. 17. Q R S T alſo ſhews a ſand of the aforeſaid ſtone, in which the diamond is better cut than in the former.

Fig. 18. V W X Y Z repreſents two grains of ſand, that were ſtill join'd to each other; the one is ſhewn by V W X, wherein you may obſerve ſeveral points, and particularly between W and X; and the other is repreſented by X Y Z, and moſt of its points lie between Y and Z; now as ſome of the ſmooth ſides of theſe ſands were large, and others ſmall, and that all of them were not ſo ſmooth as poliſh'd glaſs, and had ſeveral ſmall

ſcratches

ſcratches or ſlits, he ſuppoſes that might happen by the breaking aſunder of theſe ſandy particles from each other; that piece of the red ſtone that ſtill remain'd entire was about the bigneſs of a pea, and when he beat it to pieces there flew a ſpark of fire out of it; he made a ſmall bit of it glowing hot, and ſo he let it drop into water, ſuppoſing that not only the particles of ſand would be ſeparated thereby, but that the red matter which conſolidated the ſand would alſo be divided from it; but he found that the ſands only were ſeparated from each other, and each particle thereof was as ſtrong as if it had never been in the fire, and alſo ſurrounded with the red matter; but in ſome of them, which had aſſum'd a greater tranſparency than before, he could plainly diſcover, that each particular grain conſiſted, or rather was a congeries of ſeveral ſmall particles, of which you could ſee in ſome grains, 50 ſuch, ſtanding out like pointed pyramids all tranſparent, and ſome of them had the ſame figure as the grain of ſand itſelf had: By theſe obſervations he was fully ſatisfied, that the ſands of which the above-mention'd red ſtone was compos'd, had for the moſt part preſerv'd their original figure, and that they were ſo hard and ſolid, that their falling one upon another could not produce any adheſion, otherwiſe than by the intervention of that red matter, which was interſpers'd, and mix'd therewith.

From theſe obſervations M. *Leewenhoeck* was naturally led to conſider diamonds; and his hypotheſis is, that all the diamonds that have or ſhall be diſcover'd, do not grow, nor are made in any ſeries of time, but were form'd like other ſands, at the beginning of the world; for how is it poſſible that ſuch a pellucid body can be produced in the bowels of the earth, by a congealing or coagulated *Succus* or moiſture; and if it were ſo, why don't we meet with very large diamonds? For when a ſmall diamond is once form'd, there would be a more than ordinary conflux of the ſame plaſtic matter thereto; as we find in other things, where ſubſtances have a ſtrong tendency or inclination to thoſe of a homogeneous nature with themſelves: M. *Leewenhoeck* has been aſſur'd, that in ſome places, water filtrates thro' the rocks into the ſubterraneous caverns, and coagulates at the top of thoſe vaults into icicles, and at laſt are really petrified; we may allow this to be true; and further, were theſe icicles (which he looks upon to be nothing elſe but a petrified ſalt) to be obſerv'd with a microſcope, and compar'd with the ſame particles of the rock, from whence the above-mention'd filtration proceeds, he makes no manner of doubt, but that theſe icicles would be

found to differ from the other; to be ſatisfied in his above-mention'd obſervations, he took a piece of white marble brought from *Italy*, which was of two ſorts; the one was ſtrong, and the other light and very brittle; he broke the brittle marble as gently as he could, that the configuration of the ſmall particles might not be much alter'd; and having view'd ſeveral of them with his glaſs, he ſaw abundance of ſurpriſing particles, which may juſtly be ſtil'd ſands with their regular ſides and angles; and ſeveral of them were of the ſame figure with the ſhining ſand; but not being ſatisfied with this hypotheſis; *viz.* that the above-mention'd particles were originally nothing elſe but ſand-particles, with their angles and ſmooth ſides; and that at the time of their coalition or falling upon each other, they were all ſoft and flexible, and thereby were ſo rivetted and join'd together, as to become one ſolid body, which we call marble; and that conſequently, the ſaid particles did for the moſt part change their figure, and aſſume another form, proportionable to the ſolidity of their coalition; and that ſome of them had ſtill preſerv'd thoſe ſmooth ſides and angles, which they had at the time of their coalition; which ſides and angles repreſent the points that are found in diamonds; and that in one particle of ſand you might diſcover three, and in another ſeven neat and regular points: From theſe obſervations, M. *Leewenhoeck* ſuppos'd, that almoſt all the ſand of the whole earth has preſerv'd the figure given it at the creation, and that the particles thereof, before they happen'd to collide or fall upon others, were compos'd of ſuch hard bodies, that they could not be join'd to them, and ſo remain'd what they originally were; only that by their colliſion with other bodies, their firſt figure might be ſomewhat impair'd; and the nearer they lie to the ſurface of the earth, the more ſubject they are to ſuch alterations; when he oppos'd ſuch a diamond-like ſand with its point to the ſight, he could ſee its point, but the ſides from whence the points ariſe, were more obvious; and in ſuch a poſition the ſand would appear four, five, or ſix ſided; and not only ſo, but where two ſides join'd, he could alſo perceive ſuch a point of a diamond-cut ſtanding out.

Fig. 19. A B C D E F repreſents one of the grains of ſand of which a great number compoſe the above-mention'd white *Italian* marble, wherein at each of the letters you may ſee its points or angles.

Fig. 20. G H I K L M ſhews the ſecond ſand and theſe letters the ſeveral points.

Fig.

Fig. 21. NOPQ is the third ſand (which and the two former was ſeparated from each other) wherein there is ſuch a flatneſs, as is obſervable in few ſands; he alſo took a little piece of the ſaid marble, whoſe parts were very cloſe and compact, and making it red hot he dropp'd it into water; in doing which, he obſerv'd that not only the ſand-particles were ſeparated from each other, but ſome of them were broken off with ſuch violence, that they were thrown out of the water; he took ſome of this water directly, in order to ſee what ſalts were communicated from the ſtone thereto; and he ſoon perceiv'd a ſort of film or ſcum over the water, without being able to diſcover any particles in the ſaid ſcum, which he ſuppos'd to conſiſt of coagulated ſalts; and that there were ſome ſuch under the ſcum he had reaſon to believe, but they were ſo obſcure, that he could not well perceive them, and the more ſo, becauſe they were hid by the ſaid ſcum; he then took a large piece of the above-mention'd marble, and heating it red hot, he alſo dropp'd it into the water; whereupon there came a thicker ſcum over it, which he let lie upon the water 24 hours, and then breaking it and taking a little of it out, he found it hard and petrified; and placing it before his microſcope, to diſcover (if poſſible) the figure of thoſe particles, he could not accompliſh his intention (tho' he had often repeated the trial) by reaſon of the ſmallneſs of the particles, and their ſtrict union with each other; only a few of them appear'd to him four and ſix ſided, and reflected the light from ſeveral parts; others that were bigger, were compos'd ſome of three, others of four ſmall particles, which we may ſuppoſe to be ſalt ones; ſeveral thouſands of theſe ſmall particles lay in a very ſmall compaſs; which being ſeparated and broken into pieces, M. *Leewenhoeck* ſuppos'd that each particle conſiſted of a great many more, and much minuter ones; and indeed they were ſo minute, that they almoſt eſcap'd his ſight thro' the beſt of his microſcopes: He tried ſome of the ſaid particles in a pretty ſtrong fire, and he found that thereby they loſt ſome of their tranſparency, and were divided into ſmaller particles that were quite obſcure; after this he took a little of that water, which lay under the ſuperficies of the ſuppos'd coagulated ſalts, imagining he ſhould find ſome ſalt-particles in the ſaid water; and putting it upon three ſeveral clean glaſſes, he obſerv'd, that after the ſpace of four hours the water was quite exhal'd, and that there remain'd ſeveral 1000 ſalt-particles out of one ſingle drop of water; which ſalts were all ſeparated from each other, ſeveral of their ſuperficies being very bright, but their ſides were

opaque; and he could clearly perceive that ſome of their ſuperficies were ſhining, and their figure quadrilateral; the darkneſs of their ſides he ſuppos'd to be owing to thoſe ſalts being ſquares, like dice; between theſe lay other particles that were much ſmaller, which he ſuppos'd to be of the ſame figure too, but becauſe of their ſmallneſs, he could form no certain judgment about them; after that the water which lay very thin was ſuddenly exhal'd, he ſaw ſeveral ſalts that were larger than the reſt, and more irregular in their figures, but coagulated together, ſome of them were ſquares, but not regular; M. *Leewenhoeck* took about 10 times as much rain-water, and mixing it with the above-mention'd ſalt-water, he then obſerv'd, that the ſalts were not diſſolv'd, but emerg'd to the top; but when he preſs'd the ſame ſalt-particles under water, ſo as to wet them all over, they ſubſided to the bottom, where they remain'd, without being diſſolv'd, or uniting with the water; now ſeeing, that the great number of ſalts extracted from the aforeſaid marble are of ſo obſtinate and tenacious a figure, that nothing but fire can divide them, and that they are ſuch inflexible bodies, that they cannot be diſſolv'd in water; we may well conclude, that the grains of ſand, which compoſe ſuch ſtones, were not only ſoft at the time of their coalition, or union with each other, but that alſo at the ſame time, there interven'd a very inflexible fix'd ſalt, inſtead of mortar, between the particles of ſand; unleſs you chuſe to ſay, that each particle of ſalt does in ſome degree conſiſt of ſuch fix'd ſalts.

After this he took a piece of hearth-ſtone, call'd *Benthemer*-ſtone, becauſe found in quarries in the county of *Benthem*; this ſtone was ſo ſoft, that he could eaſily crumble it between his fingers; and afterwards viewing it with one of his glaſſes, he could perceive nothing but particles of ſand, without the leaſt ſmooth ſide, or regular angle; and moreover, it appear'd to him, that this ſand had acquir'd a ſort of conglutination, or was grown into a ſolid ſubſtance, which we call ſtone, a long time after it had been nothing elſe but ſand, and its particles had been worn and collided againſt each other; his reaſon for this is, becauſe the ſides of every grain of this ſand, that had been lately ſtone, were as full of ſmall holes and breaches as any ſand he ever ſaw; and in viewing them, a perſon would imagine that they were compos'd of thouſands of ſmaller particles; and that ſome of them were of a triangular, others of an exact flat quadrangular figure; and when M. *Leewenhoeck* obſerv'd theſe ſands at reſt, he judged that the original ſhape of ſeveral of them were hexangular

angular, and ſeveral pointed like diamonds; and thoſe points iſſu'd out from ſmooth flat ſides: He took a little bit of the ſaid *Benthemer*-ſtone, which was very hard, and wrapping it up in paper, he broke it to pieces with a little hammer, but he could obſerve no other difference between the former ſand and this; only that the particles of the laſt were much ſmaller; he alſo took a piece of an alabaſter-ſtone, and having view'd it ſeveral times, he obſerv'd after breaking or beating it very ſmall, that the little particles were very thin and tranſparent, and their figure a flat oblong ſquare, with two acute and two obtuſe angles; and tho' he ſaw amongſt them ſome others that were not quite ſo regular, yet he ſuppos'd, that the exactneſs and regularity of their figures had been loſt in the violent ſeparating them from each other; the above-mention'd particles were for the moſt part ſo exceeding ſmall, that they could hardly be ſeen thro' his beſt microſcope; but ſome of them (whoſe figure being larger, he could more eaſily diſcern) appear'd to be compos'd of very thin particles lying upon each other; now upon viewing thoſe particles of the ſtone, that were as big as grains of ſand, he found that each of them was compos'd of ſeveral thouſands of ſmaller particles, whoſe ſhape he could not diſcover; and when he made a little bit of the ſaid ſtone red hot, and dropp'd it into water, it diſſolv'd into a white ſubſtance, as fine as meal or flower, and thereby it loſt all its tranſparency; and each particle, tho' its figure had been an oblong ſquare, was now compos'd of ſuch ſmall particles, that it was impoſſible to perceive what ſhape it had; after this he took another little piece of mineral-ſtone (the 100 weight of which contains near 50 guilders of ſilver and 30 of gold) brought hither from *Sumatra*, about the bigneſs of a common bean, and putting it over a pretty ſmart fire; the ſulphur, of which there was a great deal in the mineral, ſtood in bubbles, and remain'd upon the ſtone in the ſhape of round, black, burnt globules; then he dropp'd it red hot into water, where it remain'd whole, only with this difference, that whereas before it was very hard, now it became very brittle; and having broken it to pieces, he perceiv'd that it chiefly conſiſted of irregular particles, tho' ſome few were of an exact diamond-cut; and he could ſee much more plainly than before, the globules of gold and ſilver lying ſeparate from each other; but ſome of the former were ſo exceeding minute, that they almoſt eſcap'd his ſight thro' the microſcope; and foraſmuch, as gold is not near ſo eaſy to be melted as ſilver, he ſaw ſome that the fire had not force enough to reduce to globules, and upon it there lay a ſmall globule of

lver,

ſilver, which the fire had reduced into that figure; and tho' the gold and ſilver touch'd each other, yet they were not united, becauſe the fire where that gold lay was not ſtrong enough to put it into fuſion: M. *Leewenhoeck* had often obſerv'd in theſe mineral ſtones, that one part of them was of a white, and another part a little lower in the ſame ſtone was of a dark grey colour; and that they are brought hither in little pieces, the biggeſt of which does not exceed a joint of one's finger; and that in ſome few pieces there were little cavities or breaches, wherein he never met with any metal, either gold or ſilver (for in that mineral there is no other) but oftentimes with very ſmall cryſtals, which M. *Leewenhoeck* calls ſo, from the analogy of their figures with thoſe of rock cryſtal, being tranſparent, hexangular and ending in a point or ſpire like them; theſe cryſtals were in the white part of the ſtone, but thoſe that were in the grey part were not pellucid.

Fig. 22. RSTV repreſents a ſmall particle of ſuch cryſtal, clear and tranſparent.

Some are apt to believe that theſe cryſtals are form'd by the exhaling damps or moiſture in thoſe mines, from whence the mineral ſtone is dug; but M. *Leewenhoeck* does not think ſo; for upon that hypotheſis, the whole cavities ſhould be filled with the particles; whereas we find the contrary; for he had obſerved, that not a fourth part of the cavities is filled therewith; and he had found ſome of the ſaid cryſtals in ſuch little cavities, that a ſmall pin would have filled them, and that alſo in breaches of the mineral ſtone, that were not ſo broad as the thickneſs of a ſmall pin; whereas, he could meet with none of theſe cryſtals in other cavities that were much larger; M. *Leewenhoeck* rather ſuppoſes, that moſt of the ſtony matter where thoſe cavities are found, was of the ſame configuration with the ſaid cryſtals; and at the ſame time that the particles of ſtone coaleſced or united, the intercepted air occaſioned ſome cavities, in which the cryſtals were ſhut up, and in which they acquired the figure which they now retain; in the mean time the other parts about theſe cavities were ſo firmly united, as to become a hard and ſolid ſtone: Before M. *Leewenhoeck* had conſidered the conjunction of the particles of divers ſtones, he ſuppoſed, that theſe particles were united to each other by ſuch a ſort of fixed ſalt, that nothing but fire could ſeparate; but he was afterwards convinced, that this ſuppoſition would not hold in all ſtones.

An Account of an Earthquake *in the North of* England; *by Mr.* Thoresby. Phil. Tranſ. N° 289. p. 1555.

THERE was an earthquake felt at *Hull* upon the 28th of *December*, 1703, about three or four minutes after five in the evening; it heav'd up chairs and tables and made pewter-diſhes and the windows rattle, ſhook whole houſes, and threw down part of a chimney; the ſhock came and went ſuddenly, and was attended with a noiſe like wind, tho' there was then a perfect calm; it was felt in much the ſame manner at *Beverly* and other places, and particularly at *South Dalton*; it was more violent near *Lincoln*, where it heav'd up the chairs people ſat on, *&c.* It was felt pretty much at *Selby*, as alſo near *Navenby*; the ſudden noiſe of which ſeemed to be like the rumbling of two or three coaches driven furiouſly, and it ſhook the chairs on which people ſat; and even the very ſtones were ſeen to move; a little before, there was a violent ſtorm; and at *Leeds* there was a much greater ſtorm the preceeding night and next day, than was in the ſouth parts of *England*, of which there is an account in this *Tranſaction*.

An Account of a Calenture; *by Dr.* William Oliver. Phil. Tranſ. N° 290. p. 1562.

IN the month of *Auguſt* 1693, the Dr. was called upon to ſee a ſailor on board a man of war, in a violent calenture; the patient was between 30 and 40 years of age, brown hair'd, pretty tall, but thin; when the Dr. ſaw him firſt, he found him in the hands of three or four of his comrades, who were hardly able to manage him, becauſe of his conſtant ſtruggling to get from them; the Dr. obſerved, he cried out very often, *that he would go into the green fields*; he had a furious and wild look, and every now and then he would heartily curſe ſuch as held him; the Dr. firſt of all felt the patient's pulſe, which he found to be only a diſorderly motion of the blood in the artery; and he had alſo a burning fiery heat all over his body, but he could perceive no diſtinction, or vibration of pulſe at all; the ſurgeon of the ſhip had, before the Dr. came, attempted to bleed him; but tho' the vein of the arm was fairly open'd, yet he could not procure an ounce of blood from thence; upon that the Dr. order'd the ſurgeon to open the frontal vein, which ſucceeded no better, for that ſoon ſtopped too; this put the Dr. upon trying a third time, what effects the opening the jugular vein might have; from this vein, tho' the orifice was pretty large,

large, be had about two ounces of florid thick blood, and then it quite ſtopp'd there too; upon which the Dr. ordered the ſurgeon to untie his arm, and he bled again at that orifice, but in a ſmall quantity, and then it ſtopp'd as before; however, having three orifices open at that time, they drew blood ſometimes from one, and ſometimes from the other, where they ſaw it run moſt freely; after ſeveral eſſays of this kind, the Dr. always obſerved, as the veſſels emptied, the patient bled more freely, and at laſt as faſt as he deſired: Now the Dr. was all along of opinion, that he ought to continue bleeding, till he ſaw ſome viſible alterations, and conſequently abatements of his ſymptoms; which happen'd in about half an hour's time after the Dr. ſaw the patient; and upon feeling his pulſe again, it now began to beat diſtinctly, but very quick; not long after this, (for now he had bled well enough) the Dr. obſerved that his ſtrugglings were not ſo ſtrong, that his ravings and crying after green fields ceaſed, his wild looks were much abated, and not only his pulſe recover'd its due and regular vibrations, but that the burning heat was moderated too, and the fury of his ſpirits laid to that degree, that now one man could eaſily manage him as he pleaſed; in this half hour there was taken from him about 50 ounces of blood, from the ſaid three orifices; by this time the Dr. order'd the patient to his hammack, after ſecuring the orifices from bleeding again, and directing the ſurgeon to give him an ounce of *Diacodium* in a draught of barley-water, as he went into it; upon this he ſlept 'till about noon, when he awaked, with no other complaint, but of weakneſs from the loſs of blood, and a ſoreneſs all over his body, occaſion'd as the Dr. ſuppoſes, from his violent convulſions, and endeavours to get looſe: This was the only calenture the Dr. ſaw for three years he was in the fleet, two ſummers of which he was in the *Mediterranean*, and this happened in the *Bay of Biſcay*, in the latitude of 47, in the month of *Auguſt*: The Dr. was informed that they are more frequent in warmer climates, tho' very often undiſcover'd; the reaſon of which he ſuppoſes to be this, when they are ſeiz'd with this violent heat and diſorder, which generally happens in the night, the patients ſteal privately over-board into the ſea, imagining that they are going into the green fields; for the Dr. has frequently heard in the *Mediterranean*, in ſummer time and very hot weather, of ſailors loſt in the night, which the crew took for granted were gone off, upon ſuch like occaſions, unobſerved; and this very patient was actually going over-board, when one of his com-

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panions, who had ſuſpected his deſign, caught hold of him juſt as he was going to leap off, and calling for help, ſecured him by this accident.

This diſtemper, the Dr. is of opinion, is what we call a *Phrenitis*, occaſioned by a more than ordinary effervescence and heat of the blood; which diſtracting and confounding, if not inflaming the animal ſpirits, the proper and immediate miniſters of the mind, is the cauſe of all thoſe irregular motions, violent exploſions and convulſions; and hence it is, that the animal ideas are confuſed, the imagination depraved, and all the rational functions diſorder'd; from theſe orgaſms in the animal ſpirits we may, the Dr. ſuppoſes, give ſome account of the want of pulſe too, their conſtant and impetuous motions thro' the fibres, not admitting any diſtinct arterial vibrations; and perhaps, phlebotomy did not ſucceed at firſt, becauſe the orifices contracting preſently, prevented an effuſion, to which probably, the thickneſs of the blood contributed not a little; the patient's calling out for the green fields (the true criterion of this diſorder) the Dr. takes to be owing to the violent heat he was then in, which made him fancy green fields and open air to cool himſelf in at that time, the ſhip being too warm for him under theſe circumſtances for want of air; and laſtly, calentures happen oftner by night than by day, becauſe our ſhips are cloſely ſhut up by night, and are leſs airy than they are in the day-time.

A new Diviſion of terreſtrial Animals, *with Obſervations on the* Opoſſum; *by Dr.* Tyſon. Phil. Tranſ. N° 290. p. 1565.

DR. *Tyſon* upon diſſection having obſerved the *Penis* of the opoſſum to be fleſhy, and to have no bone therein, finds it cannot be referr'd to the dog or weaſel kind, as ſome have thought; and what *Piſo* means by his *Glires majores montani*, to which he refers it, the Dr. does not here enquire; yet ſtill it muſt be acknowledged that we cannot be at any certainty in this matter, unleſs we had a more perfect numeration and deſcription of the ſeveral ſorts of animals that are in the world; and by a ſtrict enquiry into their inward, as well as outward parts, had obſerved, how gradually they differ from each other, by eaſy and gentle ſteps, the intermediate ſpecies linking the whole together; however, 'till this can be attain'd, the Dr. thinks every little help will contribute ſomewhat; and there-

fore, he here propoſes a diviſion of ſuch terreſtrial animals as have ſeveral divided claws and nails, into

Animalia.
- Χειρο-δακτυλα *ſeu manu-digitata*, i. e. whoſe feet reſemble hands, and have fingers rather than toes.
- Ποδο δακτυλα *ſeu pede-digitata*, i. e. whoſe *Digiti*, from the order of their poſition and from their ſhortneſs, as alſo their uſes, reſemble toes more than fingers.

For tho' our language makes a ſufficient diſtinction between them, by calling the one fingers and the other toes, yet the *Greek* and *Latin* languages do not; for δακτυλοι and *Digiti* ſignify both thoſe on the hand, and thoſe on the feet likewiſe; to diſcriminate them, therefore they are obliged to add another word, as *Digitus Manûs*, or *Digitus Pedis*; which ſufficiently juſtifies our diſtinction of Χειρο-δακτυλα, and Ποδο δακτυλα: Now we may obſerve theſe differences between the fingers and toes; *viz.* that the fingers are much longer, having uſually a thumb ſet at a diſtance from the range of the other fingers; and they are thus contrived, for the better holding what they have a mind to; and eſpecially in theſe animals, to aſſiſt them in climbing trees, *&c.* for catching their prey; whereas the toes are ſhorter, and are ſet in a more even range together, and better contrived for ſwift running, by which way this other ſort of animals take their prey; this latter ſort the Dr. does not inſiſt on here, but rather gives a ſubdiviſion of the former, *viz.* ſuch animals as have their feet formed like hands; now where there is a thumb, tho' we may eſteem the hand there more perfect, yet the Dr. finds it is not always neceſſary; for in ſeveral animals it is wanting, as will appear by the following ſcheme, which he propoſes only as an eſſay or hint, that may be further enlarged or amended.

Animalia Χειρο-δακτυλα, *quorum*

- *omnes ſunt manu-formes ſeu animalia quadru-mana*
  - *cum pollice in omni pede*; viz.
    - Simia { *caudata* / *non caudata*
    - Romack
    - Coati *Braſil*, &c.
  - *ſine pollice in pedibus* (*Pedes*)
    - *anterioribus*
      - Vantrevan
      - Sciurus
      - Mus, &c.
    - *poſterioribus*
      - Genus felinum
- *duo tantum ſunt manu-formes*; *viz. vel*
  - *anteriores*
    - *cum pollice*
      - Mantegar, &c.
    - *ſine pollice*
      - Cuandu *Braſil Margravii*
      - Tlaquatzin ſpinoſum Hernandez
      - Hyſtrix
      - Tamandua *Braſil*, &c.
  - *poſteriores*
    - *cum pollice*
      - Carigueya *S. Opoſſum*, &c.
    - *ſine pollice*

Under the firſt member of this diviſion Dr. *Tyſon* includes the ape and monkey-kind, which in his diſcourſe of the *Ourang Outang*, ought rather to be reckoned a four handed than a four footed animal; and conſidering how large a ſpecies of animals may be reduced under the quadru-manous kind, agreeing in this, tho' differing in other particulars, he aſſigns them a general claſs, to be afterwards ſubdivided, according to the gradual differences they have from each other; he, therefore, reduces under this head the *Romack*, tho' differing much from the monkey-kind, both in the head and face, as being quadru-manous, and as having a thumb on each hand; whether it is deſcribed by any, or what other names it is called by, the Dr. does not know; and becauſe, in its face and head it ſo much reſembles a fox, and in the reſt of its body a monkey, he calls it Αλωπη-Πιθηκος, *Vulpi-ſimia*, or the fox-monkey; the next

mentioned in this claſs; *viz.* the *Coati* of *Braſil* and *Virginia*, or the *Rackoon* or *Rattoon*, tho' it does not reſemble the monkey-kind in its body, yet becauſe it has hands like a monkey, as *Margrave* tells us, the Dr. likewiſe places it here; as may all others, whoſe feet are formed like hands, and have a thumb on each; for there are ſome that have no thumb on their fore-feet, and others have none on the hinder feet; in the number of the former may be reckon'd the *Vantrevan*, the ſquirrel and mouſe-kinds, or any others that may be obſerved to have all their feet formed like hands, only that their fore-feet want a thumb; the *Vantrevan* (as it was called by the perſon who ſhewed it in *London*) altogether reſembles a monkey; on the fore-feet it had only four long fingers and no thumb; it is a beautiful creature, very briſk and nimble in motion, and likewiſe kind; it has a very long tail, by which it ſuſpends its body as the *Opoſſum* does; the ſquirrel-kind have on their fore-feet four long fingers, on the hinder-feet five, and one like a thumb; it makes uſe of its fore-feet like hands, in holding up its food to its mouth, and lives on trees as monkeys do; but the affinity between the monkey and the ſquirrel-kinds, does better appear by ſome monkeys the Dr. had ſeen, which have a large thick furr upon the belly, and a thick buſhy tail like the ſquirrel; whereas uſually the ape and monkey are thinner of hair on the belly, and that on their tail is ſhorter; this ſort of monkey the Dr. therefore calls the ſquirrel-monkey, or *Sciuro-Pithecus*; but as its face is more like a man's or an ape's, as likewiſe its teeth, in theſe reſpects it differs much from the ſquirrel-kind; the mouſe-kind in the ſhape of its head, the long teeth before, and its large prominent eyes reſembles more the ſquirrel-kind; and it makes uſe of its fore-feet, as hands in feeding itſelf, where it has only four fingers without a thumb, but it has five on its hinder-feet, of which the innermoſt and outermoſt are placed at a diſtance from the range of the three middle fingers, like two thumbs, as may be obſerved in ſome of the lizzard-kind: Some may queſtion, why we ſhould include the cat-kind in the number of the *Animalia* Χειροδακτυλα, ſince their feet ſeem rounder, and to have toes rather than fingers; but we may obſerve, that it uſes its fore-feet like hands in climbing and catching its prey; and when it does ſo, it exerts its claws and lengthens them; but when it uſes its feet in going and running, it ſhortens them, that being moſt convenient for that purpoſe; ſo that it is well provided for both, and its *Digiti*

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are of a middle nature between fingers and toes, as they are lengthen'd or ſhorten'd; and we may obſerve, that there is on each fore-foot a *Pollex*, or thumb ſet at a diſtance from the range of the other claws, whereby they are more like hands, and on the hinder-feet there are only four *Digiti*, without a thumb.

We come next to thoſe animals that have only two feet formed like hands, and thoſe are either the fore or hinder-feet; thoſe whoſe fore-feet only are formed like hands, have either a thumb there, as the *Mantegar*, &c. or they have only four fingers, without a thumb, as the *Cuandu*, &c. The *Mantegar* is not deſcribed by any author; it is about the bigneſs of a maſtiff-dog; it meaſured from the extremity of its noſe to the *Anus* three foot two inches; the girth of the body was two foot two inches; the head 14 inches long; the forehead five inches broad; the head ſomewhat reſembling that of a horſe; the noſtrils large; the noſe of a deep *Cinnibar* colour, and the bones of the noſe are depreſſed lower than thoſe of the upper-jaw, where the ſkin was of an azure blue colour; there is a large tuft of hair on the forehead, as alſo under the chin; the forepart of the body, and the inſide of the arms and legs, are almoſt bare of hair; the hair on the outſide of them, is of a mottley brown and olive colour; it is blackiſh on the back; there were *Mammæ* on the breaſt; it has an *Umbilicus*; the *Præputium* is without a *Frænum*, as in the ape-kind, of a vermillion colour; the *Scrotum* of an azure colour; it has no tail; it is very fierce, having two long tuſks in the upper-jaw, and it is a very laſcivious animal; the fore-feet perfectly reſemble hands, having long and thick fingers, and a thumb; and all the nails of theſe fingers are flat; the nails on the hinder toes and fingers, are imbricated, not flat; and tho' the claws are pretty long, and ſomewhat imitating fingers, yet the thumb is not ſo perfect; and the whole differs from the fore-feet; when ſitting and ſupporting itſelf by a ſtick in one hand, being thus erect, and holding a cup in the other, it would drink and not lap; its food was chiefly fruits: Amongſt thoſe animals whoſe fore-feet are like hands, and have no thumb, the Dr. reckons the porcupine-kind, as the *Cuandu* of *Braſil*, a ſort of porcupine deſcribed by *Margrave*, and in *Jo. Nieuhoff's Voyages*, p. 18. which has but four fingers on the fore-feet, and five on the hinder ones; therefore as *Margrave* obſerves, for want of a thumb, it is but ſlow in climbing trees; but the better to help itſelf, it twiſts its tail about a bough, to ſave it from

from falling; and the *Tlaquatzin ſpinoſum* of *Hernandez* is much like it, if not the ſame; the common porcupine has likewiſe four fingers before, and five behind; the *Tamandua* of *Braſil*, or ant-bear, has but four fingers before, where the want of length in the fingers, is ſupplied by that of the nails, and it has five toes behind; the Dr. has ranged this anamolous animal (as Mr. *Ray* calls it) here, becauſe he climbs trees, and in ſo doing, makes uſe of his tail as ſome others mentioned here do; and we may likewiſe bring into the number, the *Ai*, *Ignavus*, or *Sloth*, becauſe it climbs and lives on trees, and has a head not unlike an ape's; and as *Margrave* aſſures us, two teats on the breaſt; but it has only three claws on each foot, with very long nails, like the *Tamandua*; and becauſe its feet are very narrow and defective in toes, it is very ſlow in its motion: In fine, amongſt the animals, whoſe hinder-feet only are like hands, is to be reckon'd the *Carigueya* or *Opoſſum*; and if there are any other animals that have their hinder-feet form'd like hands, either with or without a thumb, and have all or ſeveral of their claws formed like fingers; and if they climb or live on trees, they may be reduced to the ſame claſs of *Animalia* Χειροδακτυλα.

Dr. *Tyſon*, in deſcribing the ears of a female *Opoſſum* in a former *Tranſaction*, had not an opportunity of obſerving that white rim that incircles them, which is very beautiful; for when the animal is in health, there runs for the breadth of two lines or more, an edging round the verge of the ear, of a perfect milk-white colour; but this part of the ear being ſo very thin and tender, it is eaſily affected by cold or illneſs, and then this white part becomes jagged and crumpled, as if burnt up, and the whiteneſs diſappears; it is on this account that *Margrave*, in his deſcription of the *Tai-ibi* of *Braſil* (which the Dr. takes to be the male *Opoſſum*) ſays, it has *Aures ſubrotundas*, *molles*, *graciles*, *albas*, *teneras ut charta*; not that the whole ear was white but only the edges. In the male ſubject Mr. *Cowper* diſſected, he neither obſerved the *Marſupium*, or pouch for receiving the young, nor the muſcles belonging to it, as has been deſcribed in the female *Opoſſum*, nor did the Dr. in that he diſſected; only this he took notice of, when firſt he had it, that the ſkin in that place ſeemed to be looſer, ſo that with his finger he could eaſily thruſt it in, and by turning it round, he could for the preſent form a pouch, but this would ſoon turn out again, upon withdrawing his fingers; the Dr. therefore leaves it as a query to be reſolved by thoſe that live

when

where these animals breed, whether this part of the skin is capable of being formed upon occasion into a pouch or *Marsupium*, and whether they ever observe the male to receive the young ones, as the female does? However, there were in the male *Opossum*, those bones the Dr. calls *Marsupialia*, and he observed muscles running from them to the hinder-legs, which no doubt are very serviceable to them in drawing up their bodies; and this Mr. *Cowper* had likewise observed: The Dr. further adds, to confirm what *Oppian* and others he had mentioned in a former *Transaction* write, concerning fishes receiving their young ones into their bellies) that Mr. *Herbert*, in his *Travels* Lib. 1. p. 23, says, *That in their voyage they took a shark, nine foot and a half long, and found in her paunch 55 young ones, each a geometrical foot in length, all which,* he adds, *go out and in at pleasure.*

As to the brain, the Dr. observed that when taken out of the *Cranium*, it weighed two drams two scruples; he did not find, either in the *Cerebrum*, those *Anfractus*, nor in the *Cerebellum* those *Circilli*, which are usually met with in other brains; the whole was of an oblong figure, and seemed to be divided into three parts; *viz.* the *Cerebellum*, the *Cerebrum*, and that part of the *Cerebrum*, which was projected into the *Rostrum*; for by compressing the *Cranium* here, the fore-part of the *Cerebrum*, from whence issued the *Processus Mammillares*, and olfactory nerves, was remarkably distinguished from the *Cerebrum*, like an anterior brain; the Dr. had likewise observed this in the vermin-kind, and in those animals that have a long *Rostrum*; for nature seems to give them in that place more particularly the advantage of the sense of smelling, either for finding out their prey, or avoiding the danger they may be exposed to; the Dr. also observed the optic nerve, and the eyes, which were large; the auditory nerves were likewise large, to give these animals a quick sense of hearing upon any sudden noise, and so to avoid the danger; it was observed that it saw best in the twilight, and not so well in a bright sun; which the Dr. was readily brought to believe, because it was then to seek out for its prey; the Dr. observed in the eye the *Membrana nictitans*; the *Glandula lacrymalis* was large and oblong; there was the *Musculus septimus suspensorius*; the crystalline humour was large, very transparent and almost of a globular figure; the eye or *Iris* was black.

The

The Anatomy *of thoſe Parts of a male* Opoſſum, *that differ from the Female; by Mr.* Cowper. Phil. Tranſ. N° 290. p. 1576.

THIS male *Opoſſum* was brought from *Virginia*, and kept alive for ſome time, but falling from its meat it languiſh'd and died; the cauſe of its death appeared to be from a mortification of the *Duodenum*, immediately below the *Pylorus*; which ſeemed to ariſe from a quantity of hay, that had been collected in the ſtomach, and matted together, in the ſhape of the hairy *Tophus* Dr. *Tyſon* had found in the ſtomach of that *Opoſſum* he diſſected in *Phil. Tranſ.* N° 239, only that Mr. *Cowper* could not find any hair in this; this wad of hay ſlipping out of the ſtomach, ſtuck in the *Duodenum*, which together with the viſcid matter that involv'd it, entirely obſtructed the paſſage in that gut, as well as that of the gall into the gut, which appear'd from the diſtenſion of the liver, as well as from the fullneſs of the gall-bladder; the *Omentum*, which in this animal is only faſtened to the bottom of the ſtomach, had alſo ſuffered a mortification, as had almoſt the whole inteſtinal canal.

Beſides the organs employed in generation, the male *Opoſſum* differs externally from the female, there being no *Marſupium* or pouch for receiving the young ones; nor are there any muſcles inſerted into the ſkin of the *Abdomen* ſpringing from the *Oſſa marſupialia*, as Dr. *Tyſon* calls theſe bones, which may deſerve the name of *Hyoides*, from the figure they form with the *Oſſa pubis* of this animal; which bones do not ſeem to differ in the male from thoſe of the female, deſcribed and repreſented in the *Tranſaction* abovementioned; there is no external appearance of genitals in the male *Opoſſum* but the *Scrotum*, which is but juſt large enough to contain the *Teſtes*; nor could Mr. *Cowper* readily diſcover any other *Foramen* outwardly in theſe parts but the *Anus* A, Plate IX. Fig. 23. which leads to the *Rectum*; till upon ſtretching its ſides, he found another *Foramen* B, which on diſſection, appeared to be the *Præputium* or out-let of the *Penis*; on compreſſing the parts on each ſide of this *Cloaca* A, B, he obſerved two drops of a yellowiſh coloured liquor, reſembling *Pus*, ſtart out on each ſide the *Anus cc*, which upon further examination he found to proceed from two glandulous bodies, or bags placed on the *Sphincter* muſcle of this part; this ſort of liquor was likewiſe found by Dr. *Tyſon* in the pouch of the female; which like this, had more of the peculiar *Fætor* of this animal, than any other part beſides; for on removing theſe parts with the ſkin about

about the *Cloaca*, Mr. *Cowper* was freed from the ungrateful ſmell; and upon ſeparating the ſkin from the muſcles of the *Abdomen*, the two abovementioned bones, (peculiar to this animal) appeared, from whence ſome muſcles aroſe, and were inſerted into the *Oſſa femorum*, which performed the office of the *Pſoas* muſcles, and they were much ſmaller in this than in other animals; the abdominal muſcles were alſo faſtened to the laſt mentioned bones, particularly the *Recti*, which enabled this animal to project or ſpring its body, eſpecially in pulling its hinder legs forwards, with greater advantage and force than other animals, which are without theſe bones; immediately, under the ſkin about the *Cloaca*, he found a thin fleſhy muſcle, incloſing the *Præputium* and the lower parts of the *Rectum*, and odoriferous bags, together with the four mucous glands M M N N Fig. 24, 25, at the roof and body of the *Penis* itſelf A; all which parts were liable to be compreſſed by the action of this muſcle, eſpecially when the *Penis* is erected, whereby its erection is alſo ſuſtained, by compreſſing the two external veins on the *Dorſum Penis*; on removing this thin broad *Sphincter* muſcle, Mr. *Cowper* was obliged to clear away two lumps of hard fat, before the body of the *Penis* could be diſcovered: The *Scrotum* being removed, each teſticle appeared as repreſented on the left ſide Q T V, Fig. 24; the *Vaſa præparantia & deferentia* Q Q, being incloſed in the *Cremaſter* muſcles P P; thoſe muſcles were in proportion very large in this animal, as Mr. *Cowper* has always obſerved them in animals that have no *Veſiculæ ſeminales*, which is the caſe here; and this proviſion of nature ſeems not only neceſſary to ſuſpend the *Teſtes*, but theſe incloſing *Cremaſters* alſo compreſs the *Epididymides* and *Vaſa deferentia*, and oblige them to diſpatch their contents (*viz.* the *Semen*) into the *Urethra* in *Coitu*, which otherwiſe would have a ſlow progreſs; but this contrivance appears more peculiarly requiſite to this animal, becauſe the deficiency of the *Veſiculæ ſeminales* here, ſeems to be ſupplied by the largeneſs of the *Epididymides* of the *Teſtes* W W, Fig. 24, 25, which are their excretory ducts, and appear in this animal to have a larger bore than ordinary; for this reaſon the *Tunicæ vaginales* are very ſtrait, as in T V R R Fig. 24: On diſcovering the originations of the ſpermatic arteries, Mr. *Cowper* met with an appearance he had never heard of nor obſerved before, in which he ſhould not have had any ſatisfaction, if he had not firſt injected wax into the trunks of the great artery *i i i*, and *Vena cava h* Fig. 24. below the *Diaphragm*; in this animal the deſcending trunk of the great artery below the emulgent

arteries, is placed directly under the trunk of the *Vena cava*; nor do the iliac branches of the arteries here, twine about those of the veins, as in human bodies, and in some quadrupeds, which is done, perhaps to compress the channels of the veins, and by means of the pulsation of these arteries to propel the blood in the veins towards the heart; but that contrivance seems no way necessary in this animal, because the contrary position of its body is more customary in hanging by its tail with its head downwards; it is not unlikely if the veins of this animal had been examined below the heart, but we should meet with some contrivance to prevent the precipitate flux of blood in that pendulous position, as Mr. *Cowper* has observed in the trunk of the *Cava* in dogs, immediately above the liver.

The spermatic arteries *a a* Fig. 24. arise from the descending trunk of the great artery, and pass thro' a very small perforation * - - - - made on purpose in the *Vena cava*, and descend strait to the *Testes*, as in human bodies; and are not contorted, as they are found in most if not all quadrupeds; perhaps this perforation of the *Cava* was not only designed for transmitting the spermatic arteries, but might also frame an *Annulus*, to check the velocity the blood would otherwise have in those arteries, which rapid motion of the blood we find nature studiously avoids in the *Testes* of all animals; for in men we see these spermatic arteries (contrary to all other trunks of arteries) are smaller at their originations from the great artery; and in quadrupeds, excepting in this, the spermatic arteries are contorted before they reach the *Testes*. These spermatic veins, after leaving the *Testes* of this animal, have (like those of human bodies) several divisions and inosculations, which are all reduced to one trunk on each side, and empty themselves into the *Cava* immediately above the perforation *b b*: Upon dividing the *Tunica vaginales* R R Fig. 24, 25, Mr. *Cowper* found the inclosed testicle and its *Epididymis* lying loose, insomuch that they parted from each other as expressed W X Y Z; and with a pretty large convex-glass he could see the excretory duct Z arising from one extremity of the testick, where the spermatic artery and vein Y may be seen; after that duct has gone a little way it is folded up into the *Epididymis* W W, and at length it forms the *Vas deferens* S S; in men and in most if not all quadrupeds, the *Epididymides* and *Testes* adhere so close to each other, that without some dexterity in dissection, their origin from the *Testes* is not to be discovered: The *Vasa deferentia* S S after they leave the *Præparantia a b*, as in men and other animals, become somewhat larger, but upon crossing the *Ureters e e*, become smaller again at their entrance into the

Ure-

Urethra, immediately below the neck of the bladder; where their orifices could be perceived on each side of a caruncle; nor are there any *Veſiculæ ſeminales* near the *Vaſa deferentia* of this animal, as in boars, bulls, horſes, &c. which nevertheleſs cannot be allowed to communicate with each other, as in men; for tho' the *Vaſa deferentia* and *Veſiculæ ſeminales* of thoſe laſt mentioned animals empty themſelves into the *Urethra* at the ſame orifices with the *Veſiculæ ſeminales*, yet their communicant ducts are ſo very ſhort, that whatever comes by the *Vaſa deferentia* will ſooner eſcape into the *Urethra*, than be received by the *Veſiculæ*, as in men; the length of the *Urethra* between the bladder and the *Penis* exceeded four inches, of which more than three inches and a half was incloſed with a glandulous body, analogous to the *Proſtratæ* in men and other animals; the orifices of the ſecretory ducts of this glandulous body are very numerous, and open into the *Urethra* on all ſides, as appeared upon opening the *Urethra* and compreſſing this glandulous body or the *Proſtatæ*, its ſecreted liquor ſtarted out; this part of the *Urethra* I K K L, Fig. 24, 25, thus incloſed with the *Proſtatæ*, being very much contorted or folded in its natural ſituation between the bladder and the *Penis*, when there is no erection, muſt neceſſarily be drawn out, and become ſtrait, when the *Penis* is extruded upon an erection; by which means the glandulous body is neceſſarily compreſſed, and the *Succus proſtatarum* forced into the *Urethra*; the *Proſtatæ* of divers animals are compoſed by muſcles framed on purpoſe, that incloſe them, as in boars, rams, &c. but in men they are compreſſed by the *Muſculi levatores ani*: At the root of the *Penis* of the *Opoſſum* we meet with four glandulous *Veſiculæ* M M N N; two on each ſide, which empty themſelves into the *Urethra*, and contain a mucous matter, like that Mr. *Cowper* found in the glands he diſcovered in this part in men; theſe *Veſiculæ* are not only compreſſed by the thin broad *Sphincter* muſcle above-mentioned, but the bulbs of the cavernous bodies of the *Penis* C C and *Urethra* E E, when diſtended in the erection of the *Penis*, do alſo compreſs theſe mucous bags; this compreſſion in men is effected by the intumeſcence of the bulb of the cavernous body of the *Urethra*; in boars, rams, cats, &c. we find nature ſo ſollicitous to diſcharge the contents of the excretory ducts of theſe glands, that (like the gizzard of birds) each mucous gland is incloſed with a proper muſcle to compreſs it.

The ſtructure of the *Penis* differed in ſeveral reſpects from what Mr. *Cowper* found, in all the other animals he had diſſected;

beſides, the forked *Glans* B B Fig. 24, 25, its cavernous bodies D D had no connection with the *Oſſa pubis*, nor did the *Muſculi erectores* or *directores* C C adhere to any bone, as in men and quadrupeds, but all thoſe parts lay looſe under the *Oſſa pubis*; the other extremities of the two *Corpora cavernoſa Penis* are receiv'd into the *Glans*; neither did the *Corpus cavernoſum Urethræ*, or its muſcles E E adhere to the *Sphincter Ani*, as in moſt other animals, but the whole body of the *Penis* lay looſe between the bones of the *Pubis* and *Rectum*; ſo that on the intumeſcence or erection of the *Penis*, it is at liberty to be extruded from its *Præputium*, wherein it is ſecured from outward injuries, when not erected; to favour this extruſion of the *Penis* in this animal, the *Urethra* I K L is not only very long between it and the bladder O O, but he found it much more contorted or folded into acuter angles, than is expreſſed in the figures, elſe the *Penis* could not be extruded, but the bladder O O muſt follow it; beſides, it appears that nature deſigned this extruſion of the *Penis* in its erection, becauſe we meet with inſtruments to draw it back again into the *Præputium*; *f f* G ſhews a pair of muſcles elegantly framed for that purpoſe on the fore-part of the *Penis*; they ariſe fleſhy from the *Corpora cavernoſa Penis* D D and becoming tendinous at *f f*, as they paſs thro' two ligaments or pulleys on the *Oſſa Pubis*, they are afterwards united into one tendon G, which is inſerted at the upper part, or *Dorſum Penis*; beſides, this pair of muſcles (which perhaps is peculiar to this animal) he found another pair, that alſo withdrew the *Penis*, which ariſe from the *Rectum*, and are inſerted into the extremities of the *Corpora cavernoſa Penis*; in cats, male porpuſſes, bulls, rams and boars, we meet with two ligaments ariſing from the *Os ſacrum* or *Ilium* on each ſide, and inſerted into the *Corpora cavernoſa Penis* of thoſe animals, which like theſe muſcles ſerve to draw in the *Penis* of theſe animals into the *Præputium*: The *Corpora cavernoſa Penis* of the *Opoſſum* differ in their figure from what we find in other animals; their upper parts D D are bulbous and are covered with muſcles C C, like the bulb of the cavernous body of the *Urethra* in men; but in other animals thoſe parts of the *Corpora cavernoſa Penis* are of a conical figure; the muſcles of the cavernous bodies of the *Penis* in this animal having no connection with the *Os pubis*, cannot apply the *Dorſum Penis* to the laſt named bone, and compreſs the vein of the *Penis*, thereby to retard the refluent blood, and cauſe an erection as we have obſerved in other animals, but ſome large veins of the *Penis* in this place take a different courſe, and paſs thro' the

middle

middle parts of the bulb K K C Fig. 26. and are only liable to the compreſſion made by the intumeſcence of theſe muſcles C C, that incloſe them; but the chief agent in continuing the erection of the *Penis* in this animal, is the *Sphincter* muſcle of its *Anus* or rather *Cloaca*, to which the broad *Sphincter* muſcle above-mentioned is continued, and does ſomewhat contribute; when the *Penis* is extruded from the *Cloaca* (which muſt happen when it is erected) the *Sphincter* of that part neceſſarily embraces it, and the like muſt be done by the *Sphincter* muſcle of the *Cloaca* of the female *in Coitu*; and upon theſe accounts Mr. *Cowper* is apt to think, theſe animals are not very quick in that act; beſides, the ſhape of the *Penis* ſhews an unfitneſs for its retraction, 'till there is a detumeſcence of its *Glans* A B Fig. 26; which perhaps does not happen in theſe animals 'till both male and female are ſatiated, as in dogs and other animals that have bones in their *Penis*, and have a bulbous intumeſcence of the *Glans in Coitu*, and no *Veſiculæ ſeminales* as in this animal, and do alſo impregnate the female with more than two or three at a time, as the *Opoſſum* does: As the bulb of the cavernous body of the *Urethra* in man, is framed for the uſe of the *Glans*, to keep it ſufficiently diſtended when required; ſo it ſeems, that it is neceſſary to have two of thoſe bulbs incloſed with their particular muſcles E E Fig. 24. in this animal, to maintain the turgeſcence of its doubled or forked *Glans* A B Fig. 26. when the *Penis* is erected; in this diſtenſion of the *Glans Penis*, the middle part of the orifice of the *Urethra* (where you ſee the probe paſſing out of Fig. 25.) is neceſſarily compreſſed, as repreſented by D Fig. 26. and two diſtinct apertures C C are left open, as appears by A B on each ſide its forked *Glans*.

Such as ſuppoſe that an *Aura ſeminalis* of the male, paſſes by the way of the blood of the female, to her *Ovaria*, to fecundate the *Ova*, will here find an inſtance, which Mr. *Cowper* muſt leave them to ſolve; for to what end has nature contrived a double *Glans*, and two diſtinct apertures therein (when its *Penis* is erected) for the *Semen* of the male *Opoſſum*, ſuppoſing ſhe has deſigned the impregnation of a double *Uterus* of the female? Certainly one paſſage in the *Glans Penis* would have been ſufficient to convey the *Semen maſculinum* to the maſs of blood of the female, in the manner they ſuppoſe, had not the propagation of the ſpecies depended thereon; and doubtleſs, it was for that end chiefly, that the *Penis* of this animal differs ſo much from what we meet with in others; nor could its *Penis* in theſe circumſtances be expoſed in a *Præputium*, as in other quadrupeds,

peds, by reaſon of the numerous accidents that would certainly attend in this animal's way of living; nor could its *Penis* be thus retracted, when not erected, and ſufficiently extruded, when it is, if (as in other animals that are alſo retrouningent) the *Penis* of the *Opoſſum* had been faſtened to the *Oſſa pubis*.

Thus we ſee, that nature in theſe inſtances, accompliſhes the ſame ends by different methods; tho' there are no *Veſiculæ ſeminales* in this animal, as there are in dogs, weaſels, &c. yet we find its *Penis* without a bone, as in thoſe animals; but then we meet here with additional contrivances to maintain its erection; and not only the *Sphincter* muſcle Fig. 25. of the *Cloaca* of the male *Opoſſum*, but that of the female does alſo cloſely embrace its *Penis* in *Coitu*, and effectually retard the refluent blood from its *Corpora cavernoſa*, by compreſſing the veins of the *Penis* E Fig. 26; nor could the *Penis* of this animal be formed like that in boars, rams, bulls, &c. in whom the *Corpora cavernoſa* are too large, when not erected, to be ſecured within the *Cloaca* of this animal.

Fig. 23. Shews the external appearance of the genitals of the male *Opoſſum*, ſomewhat leſs than the life; A B *c c* the *Anus* or *Cloaca*; A its lower part which leads to the *Rectum*; B its upper part or the orifice of the *Præputium*, whence the urine and the *Penis* are extruded; *c c* two ſmall apertures, whence the yellowiſh liquor that had the peculiar *Fætor* of the animal, had its exit; D the *Scrotum* juſt large enough to contain the *Teſtes*; E that part of the *Abdomen* where the *Marſupium* is ſeen in the female, which here appears a little more depreſſed than in other animals: but cannot contain the young ones, as the pouch of the female does; E E the two thumbs of the hinder feet or hands.

Fig. 24. Repreſents the fore-parts of the organs of generation, done as large as the life; A A the body of the *Penis*; A B the forked *Glans*; C C the muſcles analogous to the *Directores Penis* in men and other animals, which here incloſe the *Bulbi* of the cavernous bodies of the *Penis*; D D the two *Corpora cavernoſa Penis* before they join, and form the body of the *Penis*; E E parts of the two bulbs of the cavernous body of the *Urethra*; G *f f* a pair of muſcles, whoſe two tendons *f f* paſs thro' two ligaments or pulleys on the *Os pubis*, and are afterwards united into one tendon G, inſerted into the *Dorſum Penis*, and ſerve to draw the *Penis* within the *Cloaca* after an erection; H H two other muſcles which ſerve for the ſame uſe, and ariſe from the *Rectum*, but they are faſtened to the oppoſite part of the *Corpora caver-*

cavernoſa Penis; I the *Urethra*, where it has no glandulous body incloſing it; K K the *Proſtatæ* or *Corpus glanduloſum*, incloſing the *Urethra*, which lies contorted between the *Penis* and bladder of urine in the *Pelvis* of the *Abdomen* of this animal; M N two mucous bags on each ſide, at the root of the *Penis*, which empty themſelves into the *Urethra*; O O the bladder; P P the *Muſculi cremaſteres*; Q Q the left cremaſter incloſing the *Tunica vaginalis*; R R the *Tunica vaginalis* of the right ſide, laid open to ſhew the incloſed *Vaſa preparantia* & *Vas deferens*; S S the *Vas deferens*; T V the *Tunica vaginalis* incloſing the left teſticle, with its *Epididymis* V; W X Y Z the right teſticle as it appeared upon opening the *Tunica vaginalis*; W its *Epididymis*; X the body of the teſticle; Y the ſpermatic vein and artery as they paſs to and from the teſticle; Z the excretory duct of the teſticle which could be diſtinctly ſeen ariſing from the *Teſtes* and marching to the *Epididimis* W, where it is folded up and conſtitutes that body, from whence it is continued to the bladder, and called the *Vas deferens*, S S; *a a* the ſpermatic arteries ariſing from the fore-part of the deſcending trunk of the *Arteria magna*, where they have a common duct, which is divided as it paſſes thro' an aperture * - - - - formed on purpoſe in the trunk of the *Vena cava*; *b b* the ſpermatic veins at their entrance into the *Cava*; *d d* the kidneys; *e e* the ureters; *g* the emulgent veins; Ψ part of the left emulgent artery; *h* the *Vena cava* below the liver; *i i* the deſcending trunk of the great artery; *k k* the meſenteric arteries; *l* the lower meſenteric artery, which in this animal does not ariſe from the great trunk; *m* the left *Glandula renalis*, that on the right-ſide being placed behind the trunk of the *Vena cava n*; *o* a common trunk of an artery, from whence ariſes the gaſtric, the ſuperior and inferior meſentric, and the emulgent arteries: The deſign of nature in connecting all thoſe arteries to one trunk in this animal, might be, perhaps, in favour of its uſual poſture, in hanging by its tail with the head downwards; this trunk of the arteries of the *Viſcera* of the lower belly having ſo many united forces, is the leſs liable to any compreſſion that might be made by its contained parts in that poſture.

Fig. 25. Repreſents the back part of the genitals; A the body of the *Penis*; B its *Glans*; C C the *bulbi* of the *Corpora cavernoſa Penis* covered with their muſcles; D D the *Corpora cavernoſa Penis*; E E - - - - the two diſtinct bulbs of the cavernous body of the *Urethra*, incloſed with their particular muſcles; F F G parts of the muſcles expreſſed on the fore-part

of

of the *Penis* in the preceeding figure; H H the other pair o
muſcles ariſing from the *Rectum*, and inſerted into the ſides o
the *Corpora cavernoſa Penis*; I K L the *Urethra* covered wit
the *Proſtatæ* K L K; M N the two mucous bags on each ſide
O the bladder; P the *Muſculus cremaſter*; Q the *Tunica va
ginalis* laid open; R the *Vaſa præparantia* cut from the gre
trunks; S S the *Vas deferens* on each ſide; W X Y Z; the le
teſticle, as in the preceeding figure, only, that the oppoſite ſide
here towards you; *e e* parts of the *Ureters*; * * a probe in
ſerted into a part of the *Urethra*.

Fig. 26. The fore-part of the *Penis*, as it appears when its *Cor
pora cavernoſa* are filled with mercury and dried, repreſented
large as the life; A B its forked *Glans*; C C - - - the tw
diſtinct apertures that appear in this diſtenſion or erection of
Corpora cavernoſa; D - - - the middle part of the orifice
the *Urethra*, which is ſhut up upon the intumeſcence or erectio
of the *Penis*; E - - - the two veins of the *Glans*, whic
are compreſſed by the two *Sphincter* muſcles of the male and fema
in Coitu; F the bulbs of one of the cavernous bodies of the *Pen
diſtended*; G one of the bulbs of the cavernous body of t
Urethra alſo diſtended; theſe bulbs were opened on the oth
ſide ☿ to inject the cavernous bodies with mercury, which are
expreſſed as they ought to appear on both ſides in the follo
ing figure; H the *Urethra*; I the muſcles dried, expreſſed
Fig. 24, 25, by F F, *f f* G; K *k* the veins tied up as they p
the muſcles of the *Bulbi*, to retain the mercury.

Fig. 27. Repreſents the back-part of the *Penis* expreſſed in t
preceeding figure; A B its forked *Glans*; E E parts of the ve
ariſing from the *Glans*; F F the bulbs of the cavernous bod
of the *Penis*; G G the two bulbs of the cavernous body of t
Urethra; H the *Urethra*; K K *k k* the veins tied up as th
paſs out of the *Bulbi*, to retain the mercury.

The Jeſuits Bark; *by Dr.* William Oliver. Phil. Tra
N° 290. p. 1596.

THE *Peruvian* bark comes from a tree about the bigneſs o
plumb-tree, with leaves like ivy, but a little ſmaller, whi
are always green; the *Indians* call it *Querang*; it is gather'd
autumn, at which time, the rind is ſtripp'd off all round, as w
from the trunk as from the boughs, which grows again in fo
months, as cork does; the trunk is about the bigneſs of a ma
thigh; it bears a fruit not unlike a cheſnut (excepting its oc
rind or ſhell) which is properly call'd *China China*, and
eſteem

eſteem'd by the natives beyond the bark taken from the trunk or boughs; this account the Dr. had from an apothecary in *Cadiz* in *Spain*, who had liv'd in *Peru*, and had ſeen it growing, and gather'd it ſeveral times; from which account the Dr. made this obſervation, that probably *China-China*, or the rind of the fruit, was firſt only in uſe, and the more powerful medicine, taken in ſmaller quantities; and that the bark of the tree came not into uſe till ſome time after, when the virtues of it being known in *Europe*, occaſion'd a greater demand for it.

A new Baroſcope, *and Obſervations made therewith; by Mr.* Caſwell. Phil. Tranſ. N° 290. 1597.

SUppoſe ABCD Pl. X. Fi. 1. to be a bucket of water, in which is the baroſcope *x r e z y o ſ m*, conſiſting of a body *x r ſ m* and a tube *ezyo*, both which are concave cylinders communicating with each other, and made of tin, for want of glaſs; the bottom of the tube *zy* has a lead weight to ſink it, ſo that the top of the body may juſt ſwim level with the ſurface of the water, by the addition of ſome grain-weights on the top; the water, when the inſtrument is forced with its mouth downwards, gets up into the tube to the height *y u*; on the top there is added a ſmall concave cylinder, which he calls the pipe, to diſtinguiſh it from the ſmall bottom cylinder, which he calls the tube; this pipe is to ſuſtain the inſtrument that it may not ſink to the bottom; *m d* is a wire; *m S*, *d E* are two threads, lying oblique to the ſurface of the water, which threads perform the office of diagonals; for while the inſtrument ſinks more or leſs by the alteration of the gravity of the air, there, where the ſurface of the water cuts the thread, is form'd a ſmall bubble, which aſcends up the thread, whilſt the mercury of the common baroſcope aſcends; the circumference of the body is 21 inches, therefore its area is = 35.3 the altitude *m s* = 4; therefore the ſolidity of the body is = 140; each baſe *x m*, *r s* has a convexity, whoſe altitude is = = 5; therefore, the conoid on each baſe is nearly = 11 $\frac{1}{2}$, therefore the whole body is = 140 + 11 $\frac{1}{2}$ + 11 $\frac{1}{2}$ = 163, and the entire altitude of the body = 4 + .65 + .65 = 5.3; the inner circumference of the tube is 5,014, therefore its area *n* = 2; the length of the tube = 4, 5; therefore the tubes capacity is = 9; therefore C the contents of the body and tube = 163 + 9 = 172 cubic inches, which is almoſt two quarts and a half; ſuppoſe the greateſt preſſure of the air to be = 30.5 inches of mercury = 30.5 × 14 = 427 of water, and *f* = 427; therefore *fc* = 73444; put *a* for the depth *o u* of the air in the tube,

when the body is all immers'd, the air in the inſtrument, on immerſion, contracts ſomewhat by the cold of the water; this contraction Mr. *Caſwell* finds to be nearly as much as would be produced by an addition of one inch to 427, the altitude of the atmoſphere in cold weather, but in warm weather it is probably twice as much; but we will now ſuppoſe it $= 1$; therefore the depth of the ſurface of the water in the tube below the ſurface of the outer water is $= b + a$; therefore, the preſſure on that inner ſurface is as the altitude of the atmoſphere above it $= f + b + 1 + a = F + a$, putting $F = f + b + 1$; then ſeeing that the ſpaces, into which the air is contracted, are reciprocal to their reſpective preſſures, and that whilſt the inſtrument is out of the water, the preſſure f anſwers to the ſpace C; therefore $F + a : f :: C : \frac{fC}{F+a}$ = the ſpace which the air takes up in the inſtrument under water; therefore $\frac{fC}{F+a} = d$ = that part of the tube which is poſſeſs'd by the air $= an$ (ſuppoſing the tube's area $2 = n$) therefore $fC = Fd - ad = Fan + aan$, therefore $aa + F + \frac{d}{n} \times a = \frac{fC - Fd}{n}$; put $F + \frac{d}{n} = 2g$; therefore $aa + 2ga = \frac{fC - Fd}{n}$; therefore $a = \sqrt{\frac{fC - Fd}{n} + gg} - g$; then ſuppoſe the gravity of the atmoſphere leſs, ſo much as to ſink the mercury $\frac{1}{10}$ of an inch $= 1.$ of water; and therefore, putting $\varphi = F - 1.4$, and in the laſt equation α inſtead of a, and γ inſtead of g, you have $\alpha = \sqrt{\frac{fC - \varphi d}{n} + \gamma\gamma} - \gamma$; thus Mr. *Caſwell* finds

$a = 2.72$
$\alpha = 2.94$ } and therefore $\alpha - a = .22$; which $.22 \times n$ gives .44 cubic inches (and ſuppoſing a cubic inch $= 253$ grains) $.44 \times 253 = 111$ grains weight of water, that was got up into the tube in the firſt caſe more than in the ſecond; and therefore, the baroſcope requires an addition of 111 grains on its top to ſink it to the level of the water in the ſecond caſe, more than in the firſt; and this upon the ſinking of the mercury in the common baroſcope only $\frac{1}{10}$ of an inch; now one grain in this new baroſcope is nearly as diſcernible as $\frac{1}{10}$ of an inch in the common one; ſo that this new baroſcope is 111 times more exact than the common one.

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Put $f = 247$; $c = 172$; $d = 163$; $n = 2$ as above, only change F, putting it 437.35; that is, ſuppoſe the body ſunk in water four inches lower; in this caſe $\alpha = 208$; therefore $a - \alpha = .64$, which multiplied into $\varphi n = 1.28$ cubic inches, which $\times 253$ gives 324 grains; and the body's top $x m$ being ſunk four inches under water the body becomes ſo much the heavier, than whilſt $x m$ was at the ſurface of the water; therefore this 1.28 divided by the aforeſaid depth 4, gives .32 the area of the top-pipe, ſuch as would balance or buoy up the body at any depth; ſtrictly ſpeaking, the pipe ſhould be gradually bigger upwards in order to ſuſtain the inſtrument at any depth, but as to outward appearance it is cylindrical, and its circumference $= 2.005$; but as to that, the leaſt alteration of the air would make $x m$ the top of the body in that caſe paſs thro' the 4 inches (which 4 inches he ſuppoſes for all the variety of depth the inſtrument has room given it on the bucket to aſcend or deſcend) therefore, the pipe is made a ſmall matter bigger; *viz.* its circumference is 2.14, whereby the pipe, according as the body ſinks more, gives more reſiſtance to the deſcending body; the pipe's area is .3643, therefore the capacity of the pipe in 4 inches altitude is $= 1.457$; but in order to give no reſiſtance, its capacity as aboveſaid ſhould be 1.28, therefore this 1.28 taken from 1.457 there remains .177 the actual reſiſtance in 4 four inches depth; *viz.* $.177 \times 253 = 44$ grains: But this reſiſtance will not be the ſame in all weathers; in order therefore to calculate what it will be, when the mercury of the common baroſcope is very low; for inſtance, but 28 inches high $= 392$ of water; f muſt be ſuppos'd $= 392$; therefore, $F = f + b + 1 = 398.3$; and the reſt as before; *viz.* $d = 163$; $fc = 67424$; $Fd = 649229$; thence by the aforeſaid equation $\left.\begin{matrix} a = 2.59 \\ \alpha = 2.84 \end{matrix}\right\}$ therefore, $\alpha - a = .25$, which $\times n$ gives 50. cubic inches, which $\times 253 = 126$ grains; ſo that this baroſcope, when the mercury is loweſt, is 126 times more exact than the common one, ſuppoſing the body immers'd anew when the mercury is ſo low; next, whilſt the mercury is ſo very low, ſuppoſe the top of the body depreſs'd 4 inches under water; therefore, $\varphi = F + 4 = 402.3$; the reſt as before; *viz.* $fc = 67424$; then, α will be 1.9; but before, whilſt the top of the body was at the ſurface, α was 2.59; therefore the difference $.69 \times 2$ the area of the tube, gives 1.38 cubic inches, which $\times 253$ gives 349 grains; and ſo much heavier is the baroſcope, when the top $x m$ is 4 inches under water; or which comes to the ſame, ſuppoſing that mercury at 28, and $x m$ at the ſurface, this

baroſcope by the mercury's aſcending $\frac{1}{14}$ of an inch will become 349 grains heavier; the pipe's capacity in 4 inches altitude was 1.457, from which ſubſtracting the abovesaid 1.38, the reſidue is = .077, which × 253 gives 19 grains in 4 inches; ſo that the pipe will ſuſtain the baroſcope, and alſo 44, when the mercury is 30 and $\frac{1}{2}$ high, and but 19 grains, when the mercury is 28 high; the fewer grains difference there are in its ſinking, thro' 4 inches, the more nice the baroſcope will be: Where the thread cuts the ſurface of the water, there is form'd a bubble; therefore, whilſt the inſtrument ſinks 4 inches in water (which is all the room Mr. *Caſwell* gives it) the bubble moves 20 inches on the diagonal threads; therefore it follows, that 120 grains difference would make the bubble go over the ſpace of 120 inches, were the threads ſo long; but as it has been calculated above, about 120 grains difference of weight in the inſtrument is produced by ſo much of the alteration of the air, as would make the mercury of the common baroſcope $\frac{1}{10}$ of an inch; therefore when the mercury aſcends $\frac{1}{10}$ of an inch, the bubble of this new baroſcope aſcends 120 inches; therefore this new baroſcope is about 1200 times more exact than the common one: Mr. *Caſwell* made the following obſervations with this new baroſcope,

1. Whilſt the mercury of the common baroſcope is often known to be ſtationary 24 hours together, the bubble of the new baroſcope is rarely found to ſtand ſtill one minute. 2. Suppoſe the gravity of the air increaſing, and accordingly the bubble aſcending; during the time that it aſcends 20 inches, it will have ſeveral ſhort deſcents, of the quantity of $\frac{1}{2}$, 1, 2, 3, or more inches, each of which being over it will aſcend again; theſe retroceſſions are frequent, and of all varieties both in quantity and duration; ſo that there is no judging of the general courſe of the bubble by bare inſpection, tho' you ſee it moving, but by waiting a little time. 3. A ſmall blaſt of wind will make the bubble deſcend; a blaſt that cannot be heard in a chamber, will ſenſibly force the bubble downwards; the blaſts of wind ſenſible abroad cauſe ſeveral of the above-ſaid retroceſſions, or accelerations in the general courſe; as Mr. *Caſwell* found by carrying his baroſcope to a place, where the wind was perceptible. 4. Clouds make the bubble deſcend; a ſmall cloud approaching to the *Zenith* has more effect than a large cloud near the *Horizon*; the bubble deſcending in cloudy weather, a break of the cloud, or clear place approaching to the *Zenith* has made the bubble aſcend; and after that break had paſs'd a conſiderable way beyond the *Zenith*, the bubble deſcended again. 5. All clouds excepting one, hitherto

therto obſerv'd by Mr. *Caſwell*, made the bubble deſcend; but at one time the wind being north, and the courſe of the bubble deſcending, he ſaw to the windward a large thick cloud near the *Horizon*, and the bubble ſtill deſcended; but as this cloud approach'd to the *Zenith* it made the bubble aſcend, and it continu'd aſcending, till the cloud was paſs'd, after which it reſum'd its former deſcent; it was a cloud that yielded a cold ſhower of ſmall hail.

Concerning Foſſils; *by Mr.* Edward Lhwyd. Phil. Tranſ. N° 291. p. 1566.

THE ſtate of foſſils is quite different in *Eſſex*, from what it is in *Wales* and *Ireland*; in theſe latter countries the ſhells are generally cryſtalline; but in *Eſſex*, and ſometimes about *Oxford*, they are teſtaceous; which difference is, doubtleſs, to be attributed to the ſoil, and particularly, to the chalk and flint of *Eſſex*, which all thoſe countries want, excepting a ſmall part got in the north of *Ireland*; but there it is remarkable, that their chalk is abſolutely petrified; he means, that whereas the flints are in *England* imbodied in chalk, they are there in a chalk-white lime-ſtone; and as chalky countries alone afford thoſe *Echinitæ* Mr. *Lhwyd* ſtiles *pileatus*, *galeatus* & *cordatus*; ſo he could never find them in all his travels, but at that place; from whence the *Druids* did in time of *Paganiſm*, procure them, and ſold them amongſt our northern *Britons* for ſtones of miraculous efficacy againſt perils by fire and water; perſuading the vulgar that they were generated in cocks knees, as thouſands in the *Highlands* fooliſhly believe at this day. Mr. *Lhwyd* was ſurpris'd that ſo many foſſils found in *Eſſex*, were ſcarce diſtinguiſhable from ſea-ſhells, for the caſe is otherwiſe in thoſe places he ſearch'd; about *Oxford* they have, indeed, one or two foſſil-ſhells of a teſtaceous ſubſtance, but in colour they differ farther from thoſe of the ſea, than the *Eſſex* foſſils do, where they are ſometimes found imbodied in ſolid ſtone, which takes off any objection ſome might offer, of their being ſcatter'd accidentally by gulls, crows, &c. on the *Harwich Cliffs*.

Harwich Cliffs *and* Foſſil-ſhells *found there*; *by Mr.* Samuel Dale. Phil. Tranſ. N° 291. p. 1568.

Harwich Cliff is a ſort of promontory, which divides *Orwel-haven* from the *Æſtuarium* contain'd between that and *Walton-neſs*; it is ſituated on the ſouthern part of the town, about a quarter of a mile diſtant therefrom, and it contains ſeveral

veral acres of land; its height from the ſtrand or beach to the top, is 40 or 50 foot, where it is higheſt; at the bottom of this cliff there is a *Stratum* of clay about a foot thick, over which there is another of ſtone for a foot more, in which are embodied divers ſhells (tho' but thinly) as well of the turbinate as bivalve kind, and alſo pieces of wood and ſticks; over this are divers *Strata* of a blueiſh clay, about 20 foot high or more; this clay hath *Pyrites* or copperas ſtones ſticking therein, but no ſhells that Mr. *Dale* could obſerve; above this are likewiſe divers *Strata*, reaching within two foot of the ſurface; ſome of which are only of fine ſand, having other ſmall ſtones and gravel mix'd with fragments of ſhells, and in others were ſmall pebbles; and it is in ſome of theſe laſt mention'd *Strata*, that the bivalve and turbinate foſſils are embodied, which lie promiſcuouſly together; the *Strata* with the ſhells obſerve no order in lying, being ſometimes higher and ſometimes lower in the cliff; and ſometimes two or three one above another, with other intermediate *Strata* of ſand, fragments and gravel; over all theſe, there is a covering of common ſandy earth, which is about two foot thick; in ſome places of which there are veins of a ſpecies of *Oſteocolla*, tho' more tender than the *Oſteocolla Officinarum*, which is brought from *Germany*; this Mr. *Dale* calls *Oſteocolla Anglicana*, which incruſtates round ſmall ſtrings like the fibres of the roots of trees; it is of various ſizes, and emits branches here and there; but it is ſo tender, as not to be got out of the earth in any large pieces; whether it appears above the earth, like the *German* ſort, Mr. *Dale* could never diſcover; the ſhore before this cliff, as far as the ebbing of the ſea would permit his obſervation, was rudely pav'd with ſtones, divers of which are vein'd with that ſort of ſubſtance, which by *Helmont* and other naturaliſts, is call'd *Ludus Paracelſi*; the inhabitants have a tradition, that theſe ſtones are form'd by the clay, which tumbling down from the cliff, and being waſh'd by the flowing of the ſea, are in a ſhort time converted into ſtone; and Mr. *Silas Tayler* in his manuſcript collections of *Harwich* and *Dover-court* writes thus concerning it; *The waſhing of theſe cliffs diſcovers a blueiſh clay, which tumbling down upon the ſhore, tho' waſh'd by the ſea at high water, within a ſhort time turns into ſtone; there may be ſeen ſome that are newly fallen, as ſoft as the clay in the cliff, and others that have lain longer there, cruſted over and hard, but if open'd or broke, the clay is ſtill ſoft in the middle; others, that have lain longeſt are petrified to the very middle, and with theſe the walls of the town are built for the moſt part, and the ſtreets*

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generally pitch'd: How far this is matter of fact Mr. *Dale* will not determine; and tho' he muſt at the ſame time own that ſeveral of the ſtones are waſh'd from the *Stratum* at the bottom of the cliff, yet he was ſometimes inclin'd to Mr. *Tayler*'s opinion, becauſe he liv'd a great while upon the ſpot, and by his collections ſeems to be a perſon of probity and learning; and likewiſe, becauſe, ſeveral of the ſaid ſtones have cracks or chops in them, as clay and earth commonly have by being expos'd to the ſun, and there is ſtill lying upon that ſhore a ſtone, in which a large pile (probably of oak, ſuch as was formerly made uſe of there to preſerve the cliff from the injuries of the ſea) plainly appears to have been imbedded, which can owe its ſituation to no other cauſe, than by being preſs'd into the ſuperficies of the clay while ſoft, and petrifying with it; which being ſquare, takes off an objection ſome might make, had it been round, of its being lodged there at the general deluge; Mr. *Dale* is not inſenſible that this manner of petrifaction is not only different from the common methods nature uſes in that operation, but alſo thwarts the opinions of divers learned and ingenious men; and it was ſtrenuouſly oppos'd by Mr. *Morton* of *Oxendon* in *Northamptonſhire*, when he and Mr. *Luffkin* were with Mr. *Dale* upon the ſpot; the ſubſtance of his diſcourſe was to the following purpoſe. *At Harwich, under the cliff upon the ſea ſhore, there is a* Stratum *of a clayey ſtone, which is cover'd here and there with ragged ſtones of a cloſer texture, which was formerly another entire* Stratum, *but was thus broken by the tearing of the waves*; *Mr.* Dale *and Mr.* Luffkin *were of opinion that this clayey* Stratum *had been formerly a ſofter ſubſtance, but was daily petrified by the ſea water*; *when I turn'd to the cliff I found a* Stratum *there, of the very ſame ſort of clayey ſtone with that upon the ſhore*; *yet the ſea water very ſeldom comes up hither, unleſs driven by ſtorms and at ſpring tides*; *I broke off a little piece, and then you was convinc'd that it was not harden'd or petrified by the ſea water, but in its natural ſtate*; *and I have often met with juſt ſuch ſort of ſtone in ſeveral of our ſtone-pits here in the inland country*; *it appears to me, that the water ſhould have rather ſoften'd than harden'd the ſtone upon the ſhore, tho' by waſhing away the looſer clayey matter and other earthy ſtuff, that is ſometimes left upon it at the ebb, it might ſeem to be a ſort of petrifaction, and occaſion this miſtake.*

As to petrifactions, I have only obſerv'd theſe three ſorts. 1. *A ſtony incruſtation upon ſticks, and any thing that lies in*

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the way, in petrifying ſprings; the ſoil in thoſe waters is uſually intermix'd with particles of ſtone, that trickle down into it with the water, and are there detain'd; of this firſt ſort, doubtleſs you have ſeveral inſtances in Eſſex, *and I think there is one at* Harwich-cliff; *tho' this is not ſo properly call'd a petrifaction.* 2. *The ſecond ſort is that which is perform'd by the* permeation, *or* inſinuation *of the finer ſorts of ſtony particles; as is the caſe in ſome of our petrifying waters, particularly, that at* Knaresborough; *the ſtony particles of the* Knaresborough-ſpring *are very fine; and ſeveral of the foſſil ſhells have undergone the ſame fate.* 3. *The third ſort, which indeed is a petrifaction properly ſo call'd, is often met with on the ſides of caves and grotto's, as at* Pooly-hole *in the* Peak, *and in the fiſſures and clefts of mines and quarries; of this kind are the ſeveral ſorts of* fluors, *the* Lapides ſtillatitii, ſtalagmitæ, &c. *that we meet with in the fiſſures and* Hiatus *of the earth; theſe are continually receiving an additional increaſe of real and ſolid ſtone, as is obſerv'd in ſeveral caves in the* Peak, &c. *this I take to be perform'd in ſuch a manner as the incruſtations are;* viz. *the particles of ſtone are brought along with the water as their vehicle, and at length are depoſited upon the ſides of the cave or fiſſure; but here the particles of ſtone are exceeding minute and fine, and do thereby naturally concrete and join very cloſe together; whereas, in our incruſtations, the particles of ſtone being groſſer, the ſtone is rough, coarſe, and friable; and this I leave to your judgment if it be not a more reaſonable* Hypotheſis *than that of* Dr. Plot *in p.* 33. of his *hiſtory of Oxfordſhire,* viz. that the very body of the water is turn'd into ſtone, as it chops down from the rocks: *As to that* Hypotheſis *of the tranſmutation of a* Stratum; *e. gr. of chalk to clay, of coal to common ſtone, or the like; I muſt confeſs, I never met with any thing in nature, which would countenance it, that is ſuch a tranſmutation in the bowels of the earth; nor is, there any thing that proves it, that ever I met with in any natural obſervations.*

A late author is of opinion, that *this bed of ſtones was the foundation of the loamy cliff, where the cliff has been waſh'd away or cut; and that they are the production of a vitrioline juice in conjunction with the loam; as the common copperas ſtones are produced by the ſame juice in gravel; and that the latter were only to be found, where the cliff was gravelly, and not where the loam is;* how far theſe ſtones are the effect of a vitrioline juice, Mr. *Dale* will not determine, but this he can affirm,

affirm, that he has by him ſome of the *Pyrites* or common Copperas ſtones, which he pick'd out of the clayey *Stratum* of this cliff, in which they may be frequently met with; nor did he obſerve at any time, that theſe ſtones were inveſted with either *Gypſum* or *Trichitis*, as the ſame author affirms, but with the aforeſaid *Ludus Paracelſi*, and frequently ſome other ſorts of *Lapides Stalagmitæ*.

How theſe ſhells or marine bodies came to be depoſited here, is a ſubject which has employ'd the heads and pens of divers learned and ingenious men; of which Mr. *Dale* would not pretend to ſay any thing, only make ſome remarks on the poſitive aſſertion of the aforeſaid author, concerning the imbedding of theſe foſſil ſhells in this cliff and the alteration of the channel; *viz. that this bed of ſhells, which covers the cliff, was carried thither, either at the making or clearing of the harbour; for the channel or harbour there is artificial, and of no old date, the current having been formerly on the other ſide of* Languard Fort, *which then ſtood in* Eſſex; as to the queſtion, *how elſe could the ſhells lie a-top of this cliff?* Mr. *Dale* would only aſk, why the ſame *Strata* of ſand and fragments of ſhells, with the like foſſils imbedded therein, are to be found at *Walton-neſs*, on the other ſide of the *Æſtuarium*, which is five or ſix miles broad from *Harwich*, as alſo at *Bawdſey-cliff* in *Suffolk*, which is eight or nine miles diſtant, and in other cliffs on that ſhore, where Mr. *Dale* had met with them; a ſecond queſtion may here be aſk'd, how it comes to paſs that none of thoſe *Buccinæ heteroſtrophæ* (whoſe *exuviæ* are in ſuch plenty in all the cliffs hereabouts) are not now to be found in this channel, nor in the adjacent ſea? For Mr. *Dale* cannot think, that the clearing this harbour could have deſtroy'd all that ſpecies of ſhell-fiſh, whereof there was then ſuch plenty; and therefore, ſome other original muſt be allow'd them, than what this author has aſſign'd; nor can Mr. *Dale* allow the harbour here to be artificial; becauſe, ſo great a work as this is; *viz.* the making a channel two miles wide, as it is in this place, would not have been done, without ſome notice taken thereof in hiſtory; and beſides, the earth, *&c.* which muſt have been dug up by ſuch a work, muſt, conſequently, have made a much greater hill, than the cliff ever was; and another doubt will ariſe from hence, why the workmen ſhould bring all the earth, *&c.* to this ſide of the channel, and not lay ſome of it on the other, as it is plain they did not; the ground on which *Languard-Fort* ſtands, as far as *Walton Coleneſs*, which is about three miles, is only a ſandy level or beach,

which Mr. *Dale* ſuppoſes might in time have ſubſided there, as may be obſerv'd at the mouths of other large rivers; and as to the argument our author alledges of *Languard Fort* being accounted to ſtand in *Eſſex*, to confirm his *Hypotheſis* of the change of this channel; it will be of no force with any one, who does but obſerve, that not only parts of pariſhes, but likewiſe counties, are often divided from thoſe pariſhes, and counties to which they formerly belong'd, and included in others, of which there could many inſtances be given; *e. g.* a part of *Kent* is on the *Eſſex* ſide of the *Thames*; and in *Oxfordſhire*, the pariſhes of *Shilton* belong to *Berkſhire*, *Dayleſford* to *Warwickſhire*, *Compton* to *Glouceſterſhire*, and *Stratton-Audley* to *Buckinghamſhire*, tho' all are included in the other; and there is a farm belonging to the pariſh of *Braintree*, that is ſeparated from it at leaſt two miles; and to Mr. *Dale* a probable reaſon of this fort being reckon'd in that county, is the ſands ſubſiding here, made at firſt an iſland, which lying neareſt to *Eſſex* was accounted of that county; or ſecondly, the iſland ſo form'd, belonging to none but the crown, it was at the pleaſure of the King's officers to call it of which county they had a mind; nor was it Mr. *Tayler*'s ignorance (as this author ſays) that made him mention theſe ſtones as petrifactions made by the ſea; for in his aforeſaid *Collections*, he did not omit the tradition the inhabitants of this town had, about the alteration of the mouth of this haven, as appears from his own words; *it is generally believ'd, ſays he, that* Stoure *did formerly diſcharge itſelf in a ſtreighter current than it does now, into the ſea about* Hoaſley-bay, *under the high-land of* Walton-Coleneſs *and* Felix-Stow *in the county of* Suffolk, *between which and* Languard-Fort *are (as they are reputed) certain remains of the old channel, which the neighbouring inhabitants ſtill call* Fleets, *retaining at this day the tradition of the courſe of the water, and the entrance into this haven to have been heretofore by and through them*; and Mr. *Dale* is of opinion, that this tradition is matter of fact from what he has before hinted concerning the mutations, the mouths of large rivers daily undergo, by the lodgment of ſand, &c. which may be aſſigned as a better reaſon for this alteration, than that of our author, *i. e.* that it was artificial; and the yearly waſhing of the cliff on the *Harwich* ſide does likewiſe add to its probability; it being a conſtant obſervation, that where the ſea gains on one ſide, it loſes on the other; and that this level was ſo form'd, he is confirm'd by the modern removal of the fort more towards the point, and that more ſand was added after

the old fort was built; this alteration is taken notice of by the aforeſaid Mr. *Tayler* in theſe words; *And tho' ſeveral now living pretend to remember the building of* Languard-Fort, *yet we find that there was an older fort thereabouts, A. D.* 1553, *and call'd by the ſame name, which was not far off from this modern one, a little north of it, where are ſtill to be ſeen two faces and flanks of a* Baſtion, *the reſt of it being wore away by the ſea, but in its ſtead it has left upon the ſhore a long row of ſand banks.*

The ſpring mention'd by Mr. *Edmund Gibſon* in his *Engliſh* edition of *Cambden*, from the aforeſaid manuſcript of Mr. *Tayler*, is a very ſmall inconſiderable thing; nor could Mr. *Dale* obſerve, that it petrified or incruſtrated either pieces of wood or ſticks; but he had a piece by him, which he broke off from a large pile upon that ſhore, which was petrified as far as it was driven into the earth, and the ſea water came; and he ſuppos'd that there ſtill remain ſome others of the ſame.

Mr. *Dale* has already obſerv'd, that the foſſil ſhells are imbedded in a looſe *Stratum* of ſand, gravel, *&c*; which may ſerve to demonſtrate, that their *Matrix* is not a clay-bed upon the top of the cliff; as alſo, that they could not be ſcatter'd there by crows, gulls, or other ſea-fowl, as well; as that ſome of them are likewiſe bedded in ſtone at the bottom of the cliff, yet it is only where the earth has been broken by digging of ditches, *&c.*

Mr. *Dale* found the following foſſils at this cliff. 1. *Buccinum foſſile heteroſtrophum roſtratum, lævem maximum* Liſteri *referens.* 2. *Buccinum foſſile roſtratum maximum* Liſteri *referens.* 3. *Buccinum foſſile minus ventricoſum mucrone obtuſo.* 4. *Buccinum foſſile tenue minus ponderoſum, ſtriatum & undatum.* 5. *Buccinum foſſile tenue confragoſum.* 6. *Buccinum foſſile ſtriis prominulis marginalibus inſignitum.* 7. *Buccino-turben foſſile reticulatum minus.* 8. *Buccino-turben foſſile ſulcatum.* 9. *Buccino-turben foſſile roſtratum.* 10. *Buccino-turben maximum roſtratum foſſile ſpiris intùs ſtriis elatis inſignitis.* 11. *Cochlea foſſilis maxima umbilicata quinque ſpirarum.* 12. *Cochlea foſſilis umbilicata mucrone obtuſo.* 13. *Nerita parva foſſilis.* 14. *Turbo foſſilis ſpiris duabus ſtriis eminentibus inſignitis.* 15. *Pecten minor foſſilis unica aurita.* 16. *Auricularia maxima.* 17. *Pectunculus foſſilis ferè circinatus ſtriis tenuibus valvis per ginglymon connexis.* 18. *Pectunculus foſſilis craſſus roſtro acuto ſtriis majoribus.* 19. *Pectunculus foſſilis faſciis tranſverſis undantibus notatis.* 20. *Pectunculus vulgaris foſſilis* 21. *Pectunculus foſſilis ſtriis majoribus & elatioribus.* 22. *Pec-*

unculus maximus fossilis Listerianum maximum referens. 23. *Pectunculites maximus striis latis.* 24. *Concha parva fossilis fasciis transversis insignis.* 25. *Concha longa fossilis fasciata.* 26. *Conchites lævis maxima.* 27. *Conchites parva fasciata.* 28. *Trigonella minor sive vulgatior Anglica Lithoph. Britan.* 816.

An Instrument *for seeing the* Sun, Moon, *or* Stars *pass the Meridian of any place; by Mr.* William Derham. Phil. Trans. N° 291. p. 1578.

AMONGST all the methods contriv'd for finding the meridian of any place, the most commodious Mr. *Derham* could ever meet with, or think of for common use, is an instrument of Sir *Christopher Wren*'s, or two of Mr. *Gray*'s, or one publish'd in the appendix to the *artificial Clock-maker*: Sir *Christopher Wren*'s contrivance is thus; erect a sight at one extremity of a ruler, to see the pole-star, *&c.* thro'; at the other extremity set up two circles of small wire, the one within the other; let the diameter of the innermost be equal to the double tangent of the distance of the pole-star from the *Pole*, the distance of the sight being radius; let the diameter of the outermost circle be equal to the double tangent of the distance of the next star to the pole-star, from the *Pole*; having thus prepar'd your instrument, if you look thro' the sight, and bring the two circles to the two stars, whose distances from the *Pole* they represent; a line passing thro' a sight and center of the circles is the elevation of the *Pole*; and two plumb-lines hung up, one over the sight, the other over the center of the two circles, will lie exactly in the meridian of the place.

Mr. *Derham*'s instrument is made thus of wood, or rather iron or brass, to endure the weather, without swelling or contracting: *viz.* prepare a small flat iron-bar, as C C in Plate X. Fig. 2. at each extremity of which rivet on two upright sights, to turn stiffly at the joints I I; let one of the sights *c d* have a perforation large enough to see the pole-star thro', the other sight *a b*, a very small perforation to see the sun thro'; just behind the joints fix two upright arms C D and C D, but so to bend off, as to be out of the way of the sights, when you look thro' them; these arms should be long enough for the plumb-lines to reach the pole-star on one side, and the sun at his greatest altitude on the other, when you look thro' either of the sights; therefore, the plumb-lines are tangents to their opposite sights, and their lengths may be found by a table of natural tangents, making the distance

of

of the two ſights radius; thus in the latitude of *London*, if the inſtrument be two foot from ſight to ſight, the ſouthern plumb-line ſhould be near four foot, and the northern one about two foot ten inches; on the tops of theſe two arms place two ſmall croſs pieces D E and D E, to turn with a joint at D, which croſs pieces are to hold the plumb-lines E F and E F, and to turn off and on, ſo as to bring the plumb-lines exactly to the ſights; place this inſtrument on a pedeſtal H to turn round on it ſtiffly at the pin G; the way to ſet and uſe it is thus; plant it in a convenient place, where the pole-ſtar may be ſeen by night, and the ſun by day; whenever that ſtar is on the meridian, is the time to ſet this inſtrument; *viz.* look at the pole-ſtar thro' the ſight with the larger hole *c d*, and turn the whole inſtrument about, till you ſee the oppoſite plumb-line exactly to interſect the pole-ſtar; or when you have brought the plumb-line near the ſtar, you may the more eaſily bring it to interſect the ſame, by moving the ſight *c d* backwards or forwards at the joint I, inſtead of moving the whole inſtrument; and that you may the more eaſily ſee the pole-ſtar thro' the ſight, let the plumb-line be a very fine cat-gut ſtring or horſe hair, *&c.* and if it be white, or of ſome ſuch light colour, it will be the better ſeen, with the help of a candle ſhining thereon in the night, which is neceſſary; the ſight *c d* and the oppoſite plumb-line being thus ſet in a direct line with the pole-ſtar on the meridian, it is manifeſt, that the inſtrument lies exactly in the meridian, ſo as to ſee any ſtar on the meridian to the north; and that you may ſee the ſame to the ſouth, next day, or when you pleaſe, you may hang up the plumb-line E F upon the ſouthern arm C D, ſo as that the plumb-line may exactly interſect the perforation *c d*; this may eaſily be done by moving the top joint with the plumb-line on its croſs-piece backwards and forwards, till it hangs to your mind; if the ſight with the leſſer hole *a b* be not exactly under the northern plumb-line, it muſt be brought to that poſition, by turning the ſight, by help of its joint at I; and then the whole inſtrument is adjuſted, ſo as to ſee the ſun, moon, or ſtars come upon the meridian towards the ſouth; but to ſee the ſun tranſit the meridian, it is neceſſary to guard the eye with a colour'd glaſs, or a glaſs darken'd with the ſmoke of a lamp or candle; which may be done in the following manner; chuſe two pieces of glaſs cut into the ſame ſize and figure, taking care that they do not refract, which may be known by moving the glaſs before the eye; if the objects you look on, ſeem to dance about, the glaſſes refract; but if every thing ſeems ſteady, they are true; ſmoak one of theſe

glaſſes

glaſſes over the flame of a lamp or candle, till it be ſufficiently obſcured to take off the rays of the ſun, but not ſo as to darken it too much, which may be ſeen by looking upon the ſun or candle with it; one of the glaſſes being thus darkened, lodge them both together, and faſten them in a little caſe fit for the purpoſe, with the ſmoak'd ſide innermoſt, and an edging of card between the glaſſes to keep them aſunder, ſo as that the ſoot may not be rubb'd off or diſordered; it is proper to have two glaſſes thus prepared, one for a ſtrong ſun, and the other leſs obſcured, for the ſun behind a thin cloud, miſt, *&c.* with one of theſe glaſſes held behind, or before the ſight *a b*, you may plainly ſee the ſun paſs.

To imitate the aforeſaid Inſtrument on a Journey or wherever you come.

Inſtead of an intire inſtrument, only prepare two ſights, as in Fig. 3. with holes as before; let theſe ſights be nail'd or ſcrew'd down upon the tops of two ſtakes at II, ſo as to turn ſtifly thereon; the plumb-lines, at leaſt one of them, may be hung up at the end of a houſe, as at K, or on the bough of a tree, or wherever you think fit, ſo as that the wind may not ſhake it; and the ſights muſt be ſtuck up ſo as to bring the pole-ſtar to interſect, and all be performed as has been above directed; this, tho' in a manner the ſame with the inſtrument above deſcribed, yet is in ſome reſpects more convenient; chiefly, becauſe the plumb-lines may be made longer, and the ſights ſet farther aſunder than can conveniently be done in the inſtrument; which, is ſome little advantage for ſeeing the tranſits; theſe ſights may alſo be made ſo light, as to be eaſily portable; or they may be readily made or imitated in any place wherever you come.

To know when the Pole-ſtar comes on the Meridian.

The way is thus; ſubſtract the *Right Aſcenſion* of the ſun from the *Right Aſcenſion* of the pole-ſtar, the remainder gives the degrees, minutes and ſeconds, when the pole-ſtar tranſits the meridian above the pole; divide theſe degrees by 15, it gives the hours; and every degree under 15, multiplied by 4 gives the minutes, and every minute multiplied by 4, gives the ſeconds of the apparent time of the pole-ſtar's ſouthing; it comes under the pole at 12 hours diſtance, only obſerving to make ſome ſmall allowance for the alteration of the ſun's *Right Aſcenſion* in that 12 hours time; but to ſhorten the labour, uſe tables of the ſun's *Right Aſcenſion* in time, inſtead of degrees, *&c.* if the ſun's *Right Aſcenſion* exceeds that of the pole-ſtar, add 360 degrees, or 24 hours, and then ſubſtract: The *Right Aſcenſion* of the pole-ſtar is determined by Mr. *Flamſtead*, to be $0^h, 33', 4''$ of time

time *Anno* 1690; and the increaſe of its *Right Aſcenſion* in 10 years is 1′, 16″ of time; or you may ſee when the pole-ſtar comes to the meridian, by hanging up a plumb-line, and obſerving when the *Thill-horſe* in *Charles's Wain*, called *Alioth*, comes near the line, together with the pole-ſtar on one ſide of the pole; or the bright ſtar of the third magnitude in *Caſſiopeia's Thigh* on the other ſide, as is repreſented in Fig. 4: The foregoing inſtruments may be ſet by any other ſtar as well as the pole-ſtar; but the pole-ſtar in our northern hemiſphere is moſt convenient, becauſe it makes but a ſmall circle round the pole, and therefore moves ſlower and conſequently is longer in tranſiting the meridian; and therefore, a ſmall error in calculation, or a little expence of time, in ſetting the inſtrument, may be but little regarded.

The Uſes of theſe Meridian Inſtruments.

1. You may ſee with all imaginable exactneſs, when it is noon, even to 1, 2, or at moſt 3 ſeconds of time, for you may ſee, when the very limb of the ſun touches the meridian, and whilſt all his diſk is paſſing it; ſo that it exceeds by much any ſun-dial; but beſides this, another vaſt conveniency is, that it will fit moſt latitudes; ſo that there is no need of having a ſtrict regard to the elevation of the pole, nor any danger of error in making and ſetting it, as is the caſe in moſt other inſtruments, but the whole is performed with eaſe and certainty; therefore, 2. Wherever you come, you may eaſily ſee the errors of the ſun-dials there, and which go trueſt, and which wrong. 3. As the ſun, ſo likewiſe may the fix'd ſtars be ſeen to tranſit the meridian; whereby the hour of the night may be as exactly known, as the hour of the day by the ſun, if you know the *Right Aſcenſion* of the ſtar that tranſits; for, as above, for the pole-ſtar, ſubſtract the *Right Aſcenſion* of the ſun from the *Right Aſcenſion* of the ſtar, the remainder, converted into time, is the time of that ſtar's culminating or ſouthing; and if 12 hours be added, or ſubſtracted (making due allowance for the alteration of the ſun's *Right Aſcenſion* in that time) it ſhews the exact time of that ſtar's coming to the meridian northwards. 4. The hour of the day and night being thus diſcoverable by the aforeſaid inſtruments, to 1, 2, or 3 ſeconds, Mr. *Derham* does not doubt, but that they may be uſeful in finding the exact differences of meridians, either by the eclipſes of *Jupiter's Satellites*, or the occultation of the fixed ſtars by the moon; Mr. *Derham* does not pretend, that theſe inſtruments are any otherwiſe uſeful in finding the longitude, than by ſhewing the exact time of the day or night, which is one thing abſolutely neceſſary in this matter; nor will they indeed

ſerve

ſerve without a well adjuſted pendulum, or pocket-watch, that will keep time exactly from one obſervation by the meridian-inſtrument to another; nor are they uſeful on ſhip-board, but only on land, where they may remain fix'd; tho' on head-lands or any where on ſhore, they may be uſeful to the ſeamen; and indeed till better diſcoveries are made, they may be of ſervice wherever long teleſcopes can be uſed, for ſeeing the appulſes of the moon to the fixed ſtars, or the eclipſes of *Jupiter's Satellites*; which is only on land; unleſs a convenient ſtanding for a man was contrived, and a teleſcope hung pendulouſly in a ſhip, which eſpecially in a calm ſea, might be as little ſubject to diſturbance as the pendulums of watches are, which will retain their motion at ſea. 5. You may with all exactneſs continue a meridian-line for ſeveral miles, by looking thro' either ſight, and obſerving what objects are interſected by the plumb-lines. 6. Theſe inſtruments are prepared with little coſt or trouble, and eaſily portable or imitable in any place, eſpecially the latter one.

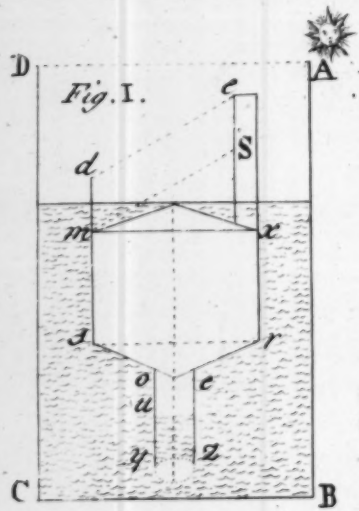
A further Account of the Pediculus pulſatorius, *or* Death-watch; *by the Same.* Phil. Tranſ. N° 291. p. 1586.

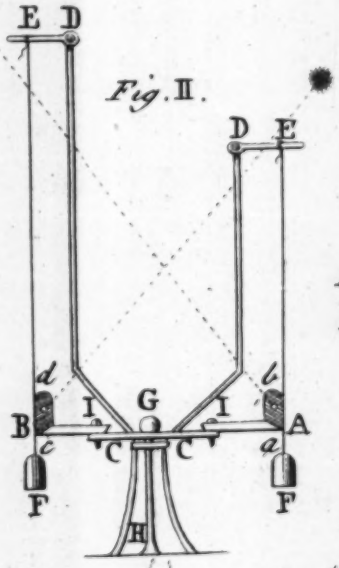
PLATE X. Fig. 5. repreſents the death-watch as it appears to the naked eye, and Fig. 6. ſhews it as magnified with a microſcope; this inſect very much reſembles a louſe in ſhape and colour, but it runs more nimbly, it is common in every houſe in the warm months, but in the cold ſeaſon of the year, it hides itſelf in dry obſcure places, and is ſeldom ſeen.

Some time after their copulation, they lay their eggs in dry, duſty places; where they meet with leaſt diſturbance; for in ſuch only, Mr. *Derham* found them; theſe eggs are exceeding minute, much more ſo than the nits of lice, tho' lice are not much bigger than this inſect is; theſe eggs are white and ſhaped like nits, but more tranſparent; and (like the eggs of all inſects Mr. *Derham* ever obſerved) are hatch'd by the warmth of the approaching ſpring, which to them is all the ſame as an incubation; the inſect is fully hatched and can creep about the beginning of *March*, or if the weather be warm, ſooner; and if cold and unſeaſonable, later; at their firſt leaving the egg-ſhell they are exceeding ſmall; ſo as to be ſcarcely diſcerned by the ſharpeſt eye, without a convex-glaſs; with a microſcope Mr. *Derham* has ſeen them crawling about, but he could ſcarcely perceive any hairs, feet, &c. but they rather looked like moving eggs; he therefore ſuppoſes, that they were incloſed in their ſhells, and but juſt beginning to break out of them; at their firſt leaving their ſhells they are

ſmaller

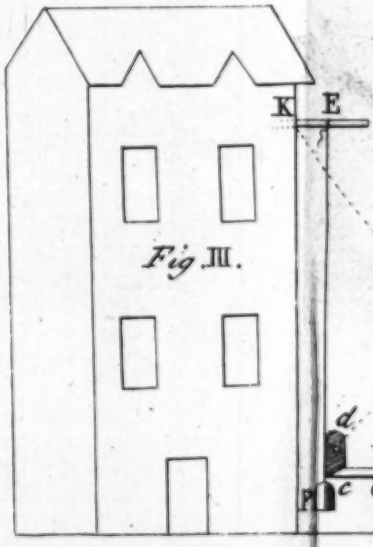
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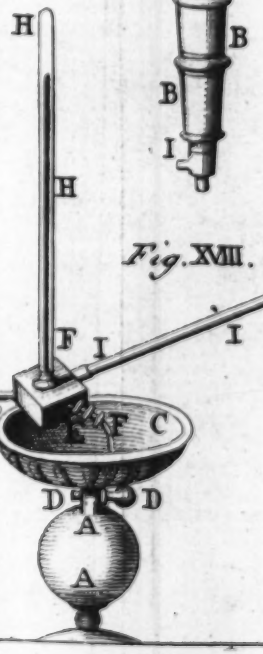






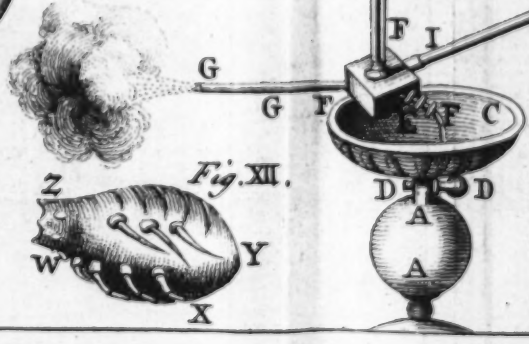


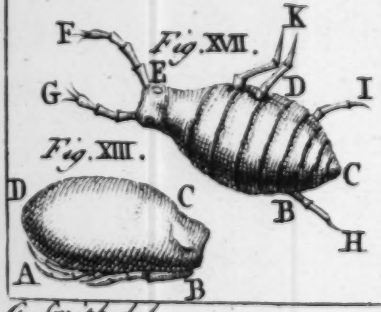






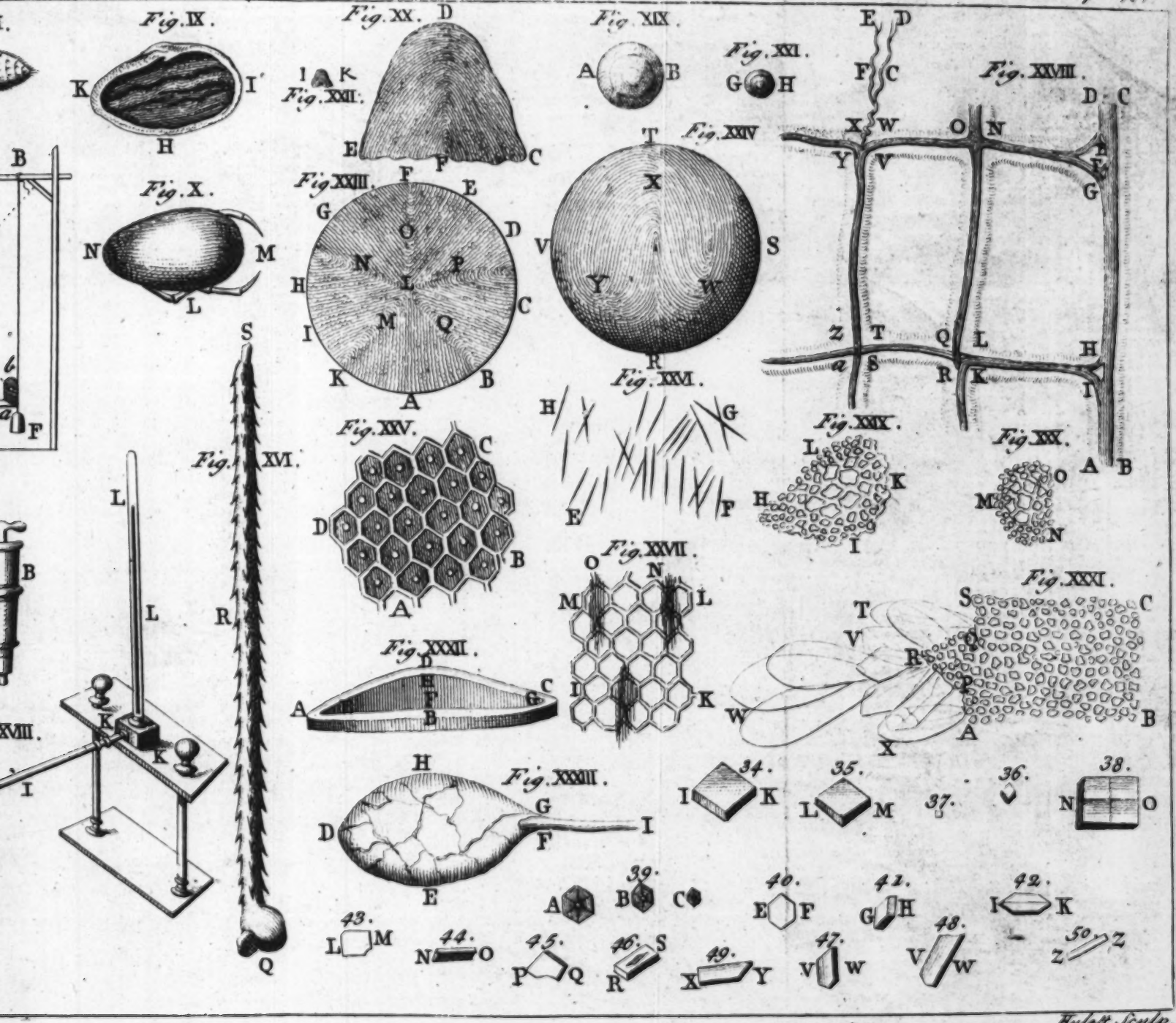








G. Smith del.


Fig. IX.
Fig. XX.
Fig. XIX.
Fig. XXI.
Fig. XXII.
Fig. XXIII.
Fig. XXIV
Fig. XXVIII.
Fig. X.
Fig. XXV.
Fig. XXVI.
Fig. XXVII.
Fig. XXIX.
Fig. XXX.
Fig. XXXI.
Fig. XXXII.
Fig. XXXIII.
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ſmaller than their eggs, tho' their ſhells are ſcarcely viſible without a microſcope; theſe young death-watches perfectly reſemble mites in cheeſe; and he could perceive no other difference between them, when much magnified with a microſcope, but only that mites have more briſtles about the breech; in this ſhape they continue for ſix weeks, or two months, feeding on divers things they can meet with; they being ſo very like mites, Mr. *Derham* could not poſitively ſay, but he had great reaſon to ſuppoſe, that they were ſwarms of young death-watches, which he ſaw feeding on dead flies, and other things in *March*, *April* and *May*; and there are ſcarcely any that eſcape theſe voracious, tho' minute animals; from this mite-ſtate they grow gradually to their more perfect ſtate; when they become like the old ones, they are at firſt very ſmall, and then they can run about more ſwiftly than when mites, in which ſtate they creep but ſlowly: Had this inſect ever been taken notice of by the ancients (as Mr. *Derham* does not find it was either by them, and but little by the moderns) they would no doubt, have made its production to be like that of other inſects, out of duſt, or ſome other thing, wherein its eggs were laid; but as in this, ſo in the generation of all other inſects, yea, all animals, it has been obſerved, that nature is very regular and uniform in deriving the offspring not from corrupted matter, but from animal parents of the ſame ſpecies; it is ſurpriſing to ſee the procedure of nature, particularly in the generation of inſects; as for inſtance, in what curious and exact order the ſeveral ſpecies of gnats lay their ſpawns; the ingenious *Swammerdam* and other authors mention but two ſorts of gnats, but Mr. *Derham* has collected near 30 diſtinct ſpecies of them; and he has obſerved, that one ſpecies lay its eggs in this, another in that, and another in a third form; and others in other forms; and he could not but be ſurpriſed to ſee how artificially the ſpawns are tied in the water, and how, after the ſun's incubation, if it may be ſo termed, the ſpawn is diſſolved, and the eggs, with a part of the jelly, in which they were incloſed, fall to the bottom of the water, and there ſtick on ſtones and other things, where they are hatched into *Nymphæ*, as various as the gnats themſelves; ſome being red, green, white or other colour'd worms, and others of quite a different ſhape; and laſtly, how theſe *Nymphæ* become *Aureliæ*, and then gnats both male and female of every ſpecies.

In *Phil. Tranſ.* N° 271. Mr. *Derham* has plainly ſhewn, that the ticking noiſe of the death-watch is a wooing act; and that it is commonly about *July*; he ſcarcely ever heard them

beat before *July*, but they beat all or the greateſt part of that month, and in the beginning of *Auguſt*; he heard them tick till *Auguſt* the 16th, but never later; but they do not beat alike every year, but ſometimes ſooner and ſometimes later; ſometimes much, and ſometimes little, according as the year excites, favours, or hinders their venereal inclinations; for he obſerved, that they tick'd very much in the year 1702, ſcarcely ever ceaſing either day or night; but in 1703 they ticked as little; in both which years Mr. *Derham* obſerved as great a difference in the fertility of other inſects; and no doubt, but the like befel the death-watch; the moſt perceivable difference was in inſects bred in the waters; which he mentions, becauſe it ſerves to illuſtrate what he was ſaying about the death-watch: Now, as to the waters, it might be obſerved, that in the year 1702, they were exceedingly repleniſhed with *Animalcula*, and you could hardly find any ſtagnating water without a great many *Animalcula* of ſeveral ſorts therein, even viſible to the naked eye; and if you viewed with a good microſcope, but a ſmall drop of water, you might ſee a great many more; ſo that the water look'd in a manner as if alive; but in the year 1703, he found ſome, tho' very few of thoſe *Animalcula*, either with or without a microſcope; the *Pediculi aquatici* (which *Swammerdam* calls *Pulices aquatici arboreſcentes*) which are ſeldom barren, were leſs numerous in our waters the ſummer of the year 1703, than they were the preceeding ſummer, by ſeveral myriads; or at leaſt, they were leſs venereally inclined, or leſs pregnant; as Mr. *Derham* ſuppoſes, from there being vaſtly leſs numbers of them congregated together; for the reaſon of their aſſembling in ſuch vaſt numbers, ſo as to diſcolour the waters, Mr. *Derham* diſcovered to be either for copulation, or to diſcharge their young out of the receptacles wherein they were lodged, or to caſt their *Exuviæ* or ſkins, or for all three together; for he has ſeen all theſe things perform'd at that time; now, as theſe very numerous fertile inſects, ſo in all probability the death-watch had its venereal flames abated by the indiſpoſition of the year; and conſequently they click'd but little; the reaſon of all which Mr. *Derham* took to be owing to the wet of the ſpring months, eſpecially *May* and *June*; in the former of which, there fell more rain at *Upminſter*, than in any other month of any year ſince 1696; ſo that this vaſt wet might not only chill, and ſpoil the eggs of the water-inſects, but likewiſe indiſpoſe the air; and by ſome ſuch means affect all other inſects, and render them leſs prolific; and not only inſects, but even corn itſelf was leſs fruitful.

After

After that they have ſpent ſome time in ticking, they copulate; Mr. *Derham* never found them *in Coitu*, till a week or a fortnight after their ticking; but it is very probable, that they copulate in the time of their ticking, as he had formerly ſhewn the *Scarabæus* death-watch does: He has ſeen the old death-watches feed upon dead inſects, as the young ones do; as alſo upon divers other things; *viz.* biſket, tallow, *&c.* nay duſt itſelf; for which reaſon, probably it is, that they delight moſt in duſty places, not in all, but ſuch as are fouled with light duſt, that flies about in ſweeping, *&c.* but in this their eating duſt, there is one thing Mr. *Derham* obſerved, which to him ſeem'd remarkable; *viz.* their curioſity in chooſing it; for they do not eat all that falls in their way, but are very nice in ſelecting what ſuits their palate beſt; having ſeen them turn the duſt and hunt amongſt it with great pains and diligence; from whence he concludes, that the death-watch, and other animals that eat duſt, are not nouriſhed by the pure terrene particles thereof, but rather by more nutritive particles intermix'd therewith; for duſt contains very different particles, ſome of earth, ſome of animals, ſome crumbs of bread, cheeſe, and other proviſions, reduced to powder; ſome particles of fruit, or ſpittle, ſnot, *&c.* dried and reduced in like manner to a powder; now, theſe very particles of the duſt, are doubtleſs what the death-watch (like ducks in mud) hunts after, when he turns up and dives amongſt heaps thereof; nay, ſo far, probably is his food from being corrupted or fouled by the terrene particles, that it is, perhaps, the better prepared by being thus mixed with duſt; for whereas, in the maſs it was more ſolid, and required gnawing and maſtication, but now it is in powder, it is ready ſubtiliz'd, and fit for deglutition; and tho' duſt ſeems to us to be nothing but dirt pulveriz'd, or if it alſo conſiſts of ſuch particles as have been already mentioned, yet it is ſo mix'd and blended with dirt, as to be inſeparable therefrom; but yet it is otherwiſe with our inſect; for Mr. *Derham* had obſerved them thro' a microſcope, ſelect the particles of duſt, and eat ſome and reject ſeveral others; which they can eaſily do, being ſmall themſelves, and having accurate organs of ſeeing, ſmelling and feeling, as well accommodated to duſt, as the organs of ducks and hogs are to find their food in dirt: Here, Mr. *Derham* cannot forbear obſerving a common error about the food of ſuch animals, as either have been, or are ſtill ſuppoſed to live upon things ſcarce nutritive of themſelves; thus the *Chameleon* was thought to live upon air, when at the ſame time they eat flies; fiſhes to live upon water, or at leaſt to ſatisfy a perpetual thirſt therewith, whereas, their ſucking

water is breathing, and their food perhaps, as little of water, as other animals uſe; ſo earth-worms are ſuppoſed to eat earth, but in all probability, it is earth formed of rotten roots, plants, or ſuch nutritive things, and not pure earth; nay, ſo neceſſary is good ſubſtantial food to all animals on this our globe, that Mr. *Derham* is of opinion, that there is no animal, no not the minuteſt inſects, but what have their proper food, and that none of the four elements is their food, tho' they may be mix'd therewith; of which ſee an inſtance of Mr. *Derham*'s about the food of *Water Animalcula* in Mr. *Ray's Wiſdom of God manifeſted in the Works of the Creation.* p. 431.

The death-watch abſtains from food, Mr. *Derham* ſuppoſes all the cold months; for you may perceive them gone very ſoon into their *Latibula*, or lurking holes, as ſoon, if not ſooner than ſwallows; where, doubtleſs they live all the winter without food, as ſeveral other animals do; Mr. *Derham* had found them lying deep in undiſturbed duſt, but never in ſhallow duſt, as if they had a foreſight of the danger and inconveniencies of cold froſty weather.

Mr. *Derham* obſerves, that the anſwer to a queſtion in the *Athenian Oracle*, where the noiſe of the *Pediculus pulſatorius* is plainly deſcribed, is by no means right; for the gentlemen of that ſociety ſay, that enquiring into ſuch a noiſe, they found a little hole eaten into the wall, that with a paper-trap they caught the inſect, which they concluded made the noiſe, and that it was a ſmall ſort of ſpider; but Mr. *Derham* owns, he himſelf had been ſo often impoſed on in the ſame manner, before he actually diſcovered the truth, that he was well aſſured thoſe gentlemen had been ſo likewiſe; for, in purſuing the noiſe Mr. *Derham* had ſometimes diſcovered a ſpider near, and ſometimes a ſmall *Scarabæus lignivorus*, which eats little holes in wood, and which has been commonly taken for a death-watch; and Mr. *Derham* ſuppoſing that theſe might make the clicking noiſe, he therefore narrowly watched them; but he found that tho' the beating continued, the inſects did not ſtir in the leaſt, nor were any ways affected; thus ſtill diligently purſuing his enquiry, he at length diſcovered the real animal; and he had been for ſo many years ſo well acquainted with all the noiſes of the death-watch-kind, that he was aſſured, there were but two ſpecies of them in thoſe parts of *England* where he had been; *viz.* the few quick beats of the *Scarabæus ſonicephalus*, as *Swammerdam* calls it, deſcrib'd by Mr. *Allen*; and the longer and more leiſurely beats of that inſect Mr. *Derham* has now been ſpeaking of; there are indeed, *Scarabæi-*

rabei-graſhoppers, crickets, &c. which make peculiar noiſes; but there are no animals that make theſe regular clicking noiſes, like the beats of a pocket-watch, but only that *Scarabæus ſonicephalus*, and the *Pediculus pulſatorius*.

An Eclipſe *of the* Moon, *obſerved near the* Royal Exchange, *in* London, *on* Sunday *Morning the 12th of* December, *Anno* 1703; *by Mr.* Hodgſon. Phil. Tranſ. N° 291. p. 1594. *Tranſlated from the* Latin.

MR. *Hodgſon*, having got ready a 12 foot teleſcope, and at four o'clock in the morning raiſing it to a proper elevation, had then great hopes of obſerving the beginning of the eclipſe; becauſe, tho' the ſky was not quite clear, yet the clouds were ſo thin, that he could eaſily ſee the moon's limb, and at times diſtinctly obſerve her principal ſpots; but about 20 minutes after four o'clock, thick clouds aroſe, which being driven from that quarter of the heavens, between weſt and ſouth, towards the oppoſite part, covered the moon in ſuch a manner that he could not ſee her at all, till 35 minutes after four o'clock, when ſhe came to view again; and then her eaſtern limb was ſeen conſiderably obſcured, reckoning three or four minutes after her firſt ingreſs into the ſhadow; but he could not diſtinctly perceive her ſpots, in order to determine where ſhe began to be eclipſed, nor in that ſhort time meaſure the quantity of the eclipſe; but four minutes after five o'clock, ſo far as he could conjecture, the moon's disk was obſcured almoſt ſix digits; he ſaw her at intervals, till 35 minutes after five o'clock, when ſhe wanted only three minutes of being totally immerſed; but at that time a ſmall, but thick cloud did ſo cover the moon, that he could ſee her no more; and tho' he was very intent to obſerve, if poſſible, her emerſion, yet he could not, both by reaſon of the groſs vapours about the horizon, and the approaching light of the day; Mr. *Hodgſon* ſaw the moon upwards of 20 times from the beginning, to the time of her immerſion; but by reaſon of the intervening clouds and the ſhort time he had to view her in, he could not pretend to determine any thing with exactneſs; and tho' this obſervation cannot be of any great uſe for examining the lunar tables, yet it may ſerve to ſatisfy and convince the curious that they are not very wide of the truth.

A Ball

A Ball *voided by* Stool; *by Mr.* Ralph Thoresby. Phil. Tranſ. N° 291. p. 1595.

AN apprentice girl at *Rawden*, four miles from *Leeds* in *Yorkſhire*, about 14 years of age, having been afflicted for ſome time with cholical, and as was ſuppoſed nephritic pains, ſhe at length voided a roundiſh ball *per Anum*, as hard as a ſtone; after ſome time, her pains returning with greater violence, ſo as to make her roll upon the ground; ſhe voided another, as hard and much bigger; upon which one Mrs. *Ward* who had been much afflicted with the gravel, gave the girl ſome of thoſe medicines ſhe uſed to take herſelf, whereupon ſhe voided a third ball *per Anum* with leſs pain, tho' it was the largeſt of the three; the firſt of theſe balls was ſmooth and gloſſy, of the colour of a hazel-nut, three inches in circumference and ſomewhat compreſſed; the other two were rough and gritty, and in like manner a little compreſſed into a kind of an obtuſe angled triangle; the ſecond ball was four inches and a half round; and the laſt was five inches and a half; conſidering their bulk, they all three were light, eſpecially the two latter and larger ones; the laſt of which weighed but five drachms and thirty-ſix grains, and both of them ſwam in water; this lightneſs proceeded from the matter whereof they conſiſted, which in ſome places was purely downy or fuzzy, in others regularly mixed with a gritty ſubſtance; the fuzzy parts poſſeſſed the central part of the ball, with a ſmall particle of blackiſh glaſs, or other vitrified ſubſtance to the very center itſelf, over which there were ſeveral gritty and fuzzy coats, alternately terminating in the circumference with the grit, much reſembling the ground-work and ſuperſtructure of the oriental bezoar ſtone; when the powder of one of theſe balls was ſcraped off with a knife, it was no ways affected with any ſort of liquor dropped thereon, either alcaline or acid; nor did it ſtink when burnt, and therefore it conſiſted of no animal ſubſtance; but the patient being of the age that girls uſually have the green-ſickneſs, the gritty parts (with the glaſſy particle in the center, as the moſt ponderous and leaſt moveable) ſeemed to have been broken off tobacco-pipes, and ground ſmall between her teeth; the downy or fuzzy parts to have been licked or ſcraped off the lean of mutton, or the rind of peaches, or of ſome other part or plant; the girl's ſtomach kneading and concreting the matter into a coat; according as her changeable appetite ſupplied it alternately with one or the other ſort.

An

An Account of Cochineel; *by M.* Leewenhoeck. Phil. Tranſ. N° 292. p. 1614.

A Merchant of *Amſterdam* obſerved that it is impoſſible, and altogether incredible that the drug called cochineel ſhould be (as Mr. *Leewenhoeck* had aſſerted) flies, or any ſort of animal with wings, head, and feet; not only if we conſider, ſays he, the vaſt numbers of them brought in every fleet from *America*; but that two of the largeſt of theſe particles, eight of the middling ſort, and 20 of the ſmalleſt, do hardly weigh a grain of gold; ſo that in a pound of them, at a medium of large and ſmall, we may compute 102400 particles; now in a fleet that carries 200000 pounds of this drug, what a vaſt number of animals muſt there be? Beſides, continues this gentleman, where can you find men enough, who at the proper ſeaſon of the year ſhall catch theſe inſects, and diſmember every individual, by pulling off its head, legs and wings, *&c.* ſo that upon the whole matter he concludes, that cochineel muſt needs be a fruit, or the excreſcence of ſome kind of plant.

Mr. *Leewenhoeck* makes an extract of what he had ſaid, *Phil. Tranſ.* N° 193. (from an account he had of a *Spaniard* of *Jamaica*, that had lived a great many years in thoſe parts) *viz.* that there is a certain plant called a prickly-pear, or *Indian*-fig, the leaves of which are round, thick and ſharp-pointed; that upon the leaves or twigs of the ſaid plant, are ſmall knobs or protuberances, from whence are produced by the heat of the ſun, little worms; that theſe worms in proceſs of time become flies, reſembling cow-ladies, or lady-birds, as ſome call them, which when arrived at their full growth, are taken in the following manner; to the windward of the plant, in which theſe animals are found, the natives kindle a fire of any combuſtible matter (having firſt ſpread cloths underneath the ſaid plant all round) with the ſmoak of which they are preſently ſuffocated; then upon ſhaking the tree, they catch them in great numbers and with very little trouble on thoſe cloths; after which they ſpread them abroad in a like cloth, on a ſandy place or a ſtone-floor, where they are expoſed to the heat of the ſun, till they are dry; that is, till their little bodies are ſhrivelled up; and they are rubbed between the hands, till their wings, legs, *&c.* fall off; and then the remaining trunks of the animals are put into ſhallow copper-boxes, till they become quite dry: The abovementioned plant has no flowers or bloſſoms thereon; its fruit is of a fleſhy ſubſtance and red; and if you handle it, when

when it is ripe, your fingers will look as if they were ſtained with mulberries; ſome ſay, that the cochineel-worms feed upon the bloſſoms and fruit of this plant, which cauſes their bodies to be of that red colour; and that if you take the ſeed of the plant or the dead worms, and dry them in the above-mentioned manner, that cochineel is not ſo good, as when thoſe animals have got wings, and then are ſmothered: Now Mr. *Leeuwenhoeck*, for his further ſatisfaction, took ſeveral particles of this ſame cochineel, as well of the largeſt as of the ſmalleſt ſort, and having diſſected them, he found, that they all had eggs in their bellies, excepting only one that was ſo exceeding ſmall, that he could diſcover none; after he had opened ſome of the largeſt trunks and ſeparated from each other, the eggs which he took out of their bodies, and counting them as nicely as he could, he judged that there were above 200 of them; and having obſerved ſeveral of them with his microſcopes, he could not only perceive a membrane or ſhell upon moſt of them, but alſo an *Animalculum* of an oval ſhape included therein, and almoſt as big as the ſhell that contained it, which ſeemed very ſurpriſing at firſt, and almoſt incredible in ſo ſmall a ſpecies of flies, as the cochineel; till by a very nice and long enquiry he was fully ſatisfied that it was really an *Animalculum* that lay within it; he purſued this his operation with ſo good ſucceſs, that he did not only ſeparate the egg-ſhell from the *Animalculum*, but in ſome of them he could alſo perceive their legs regularly folded up againſt their bodies, and could ſeparate them therefrom, eſpecially, in ſuch as were full grown; nay, in ſome he diſcovered even the ſeveral joints of the legs; and thus in the ſpace of two days he ſaw the legs of 100 *Animalcula*: A perſon muſt not imagine, that theſe *Animalcala* have ſuch ſhort legs as the catter-pillars or ſilk-worms; but thoſe that were unborn had in proportion to their bigneſs, legs as long as thoſe that were full grown; and as their legs ſtand cloſe to the head, in that part which may be called the breaſt; ſo when the ſaid *Animalculum* lay ſtretched out at its length, its little legs could be juſt ſeen peeping out of the body; the reaſon of the miſtake of ſuch as call theſe *Animalcula* worms, proceeds from hence, that thro' the exceeding minuteneſs of the object, they cannot diſcover with the naked eye, whether the new born inſect be a worm or any other ſort of animal: Two hundred or more eggs of theſe animals can lie in ſo ſmall a compaſs as a ſingle grain of cochineel; to which if you add the conſideration of the great number of blood-veſſels lying in ſo narrow a compaſs, and that each

egg

egg receives its nouriſhment and increaſe, as it certainly muſt, by a ſtring or artery; yea, and that probably, there are veins in every ſtring for carrying on the circulation of the blood, how can we ſufficiently admire the depth of almighty wiſdom! The ſhape of the eggs of the cochineel-fly, is very like that of our hen-eggs: When M. *Leewenhoeck* had viewed ſome of theſe embrio's, after he had diveſted them of the membrane, or ſhell, in which they were ſhut up, he obſerved on their heads, a kind of tool or inſtrument, about $\frac{1}{5}$ part as long as the whole body of the *Animalculum*, and a very ſlender point at its extremity, ſomething like that inſtrument which thoſe *Animalcula* have, that are found on currant-buſhes, *&c.* and by which they get their food (according to the deſcriptions M. *Leewenhoeck* formerly gave thereof) and when they have ſo done, they clap it to their breaſts till they have occaſion for it again; from whence he infers, that the cochineel-flies do alſo procure their food in the ſame manner; to wit, that they have no teeth whereby to gnaw the leaves of the plant, as ſilk-worms do, but that they only inſinuate the ſaid inſtrument into the leaves, and in that manner get their nouriſhment; and this opinion ſeems to be ſupported by what the *Spaniard* told M. *Leewenhoeck*; *viz.* that theſe *Animalcula* feed on the bloſſoms and fruits of the plant, and that by theſe means they became red; from hence we may conclude, that the inſects do not hurt the leaves, fruits, nor even the bloſſoms of trees, as far as can be diſcovered; which may alſo the better ſatisfy us, that the cochineel-flies do, by perforating the leaves with the above-mentioned inſtrument, procure both their food and increaſe: M. *Leewenhoeck* having thoroughly ſoaked ſome of the ſmalleſt particles of the cochineel in water, he found that what he had before taken to be the bodies of the male flies (as indeed we ſee that in all ſmall flies produced from worms or maggots, as alſo in fleas and lice, the ſmalleſt are always the males) were all females; and that hardly $\frac{1}{4}$ part of them was arrived to their full growth, when their bodies are full of young: This poſition of M. *Leewenhoeck*'s, that all the cochineel flies are females, may ſeem very ſurpriſing, and perhaps, not meet with credit with ſuch as maintain, that no animal can be generated without a copulation of male and female; but M. *Leewenhoeck* ſays, they would be of anorher opinion, had they ſeen the vaſt numbers of *Animalcula*, which the ſummer of the year 1703 infeſted the leaves of the lime-trees, or thoſe others that were found upon currant-trees, cherry-trees or hazel-trees; all which *Animalcula* brought forth live

young; and theſe young ones being very ſmall, had their bodies full of other young; and they were all females, and conſequently there is no copulation among them; theſe, when they are full grown, gather wings, ſo that there is no other change in them, but an increaſe of bulk, and ſprouting out of wings; now, if this be true in theſe *Animalcula*, tho' they are 50 times ſmaller than the cochineel-flies, we may eaſily believe the ſame of thoſe alſo; eſpecially, ſince the hinder parts of all of them are much alike; in confirmation of which we add, that eels, prawns, or ſhrimps have no males amongſt them: When the cochineel-flies are dry, and rubb'd between their hands, the wings are not only ſeparated from the hinder part of the body, as the *Spaniard* obſerv'd, but likewiſe the upper part, together with the legs, the wings, and the head; it may be perceiv'd that the lower part or belly of theſe *Animalcula*, is divided from the upper, by a kind of ſhort ſtring only, no thicker than a hog's briſtle; ſo that one part may be eaſily ſeparated from the other, eſpecially when the *Animalcula* are dry; now, theſe upper and lower parts of the body are placed ſo near each other, that they will eaſily appear to the naked eye to have been always united; the *Spaniard* further affirm'd, that the cochineel is not ſo good, till the *Animalcula* have got wings; from whence we might be apt to conclude, that the cochineel *Animalcula* become flying inſects all together, like ſilk-worms, which are all changed, and that in a very ſhort time from reptiles, into butterflies; but the caſe is quite otherwiſe with theſe cochineel-flies, for they do not lay their eggs all together, or in one day; but M. *Leewenhoeck* rather ſuppoſes, that one of theſe *Animalcula* brings forth at once 20 eggs, or young ones; and ſo they require above 10 days before they can be deliver'd of all; for after he had taken 200 eggs out of ſome of the cochineel-flies, he ſaw exceeding ſmall ones ſtill remaining in the *Ovarium* or egg-neſt: In his obſervations upon the lime-trees, he ſaw not only ſeveral *Animalcula* that had wings, but divers others much ſmaller, and that in a gradual deſcent, ſo far that ſeveral of them were hatch'd that very day; and theſe obſervations he did not make at one certain ſeaſon of the year, but he found that they continu'd to hatch, as long as the days were moderately warm; and M. *Leewenhoeck* ſuppoſes it is ſo likewiſe with that *Animalculum*, whoſe lower parts compoſe what we call cochineel; for when he had compared ſome of the largeſt grains of cochineel given him by three different perſons with the ſmalleſt grains thereof, as far as he could diſtinguiſh by his glaſſes, he found that 15 of the ſmall grains were hardly equal to one

one of the large ones; and upon viewing the powder, or duſt of the cochineel he had taken out of the bottom of a box, he met with ſome trunks of thoſe flies ſo very ſmall, that he judged 100 of them did not equal a large grain.

Plate X. Fig. 7. A B repreſents a grain of cochineel.

Fig. 8. C D E F G is another grain as it appear'd thro' a microſcope; C and E F repreſent the extreme parts, in which an orifice appears, where the ſtring was broken off, whereby both parts of the body were join'd together; the concave bows or circles in D E F G are not natural, but adventitious to the ſaid grain; proceeding only from the drying or ſhrinking up of the great number of eggs that lie within the *Animalculum*; for if the ſaid grain was well ſoak'd in water, theſe concave parts would become convex, and be likewiſe more obvious to the ſight, as well as the ſtem of that ſtring juſt now mention'd; but upon taking one of the largeſt grains, which is alſo ſomewhat flat, that part of the trunk will not ſhrink inwards; the reaſon of which M. *Leewenhoeck* takes to be this, that the *Animalculum* before it was kill'd, had diſcharg'd moſt of its eggs.

Fig. 9. H I K ſhews an egg with its ſhell or membrane, as it was taken out of a grain of cochineel ſteep'd in rain-water about 24 hours; in which egg might be ſeen the young one within, and the ſhell ſurrounding it.

Fig. 10. L M N repreſents an unborn *Cochineel Animalculum*, which M. *Leewenhoeck* had ſeparated from the egg-ſhell with a great deal of pains; it lay with its back to his ſight, and in ſuch a poſition as to ſhew three of its legs.

Fig. 11. O P Q R S T V ſhews a ſmall particle of the veſſels belonging to an *Ovarium* or egg-neſt; where may be ſeen divers broken filaments or ſtrings, to which the eggs were faſten'd, excepting the large veſſel repreſented by R, thro' which he ſuppoſes that ſeveral other veſſels receiv'd matter for the nouriſhment and increaſe of their eggs; S T a ſtring to which the egg T V was faſten'd in the ſame manner, as other eggs were faſten'd to the other ſtrings before he broke them off; theſe ſtrings O P Q R S were almoſt tranſparent, he could ſee other ſmall particles in them, when he took them out of the cochineel grain, and ſeparated the eggs from them; but as they began to dry, they aſſum'd a reddiſh hue; and when they were quite dry, they became of a light red colour.

Fig. 12. W X Y Z repreſents another *Animalculum*, which he alſo took out of its egg-ſhell, whoſe legs are to be ſeen very

plainly between W and X; but he could not ſee that leg which lies upon the body.

Fig. 13. A B C D is another *Animaculum* diveſted of the egg-ſhell, whoſe legs may alſo be perceiv'd between A and B.

Fig. 14. E F G H I repreſents an *Animalculum* which had lain upon a glaſs for two days; it was not much alter'd by becoming dry; it had but two legs left, the reſt being broken off; in this *Animalculum* there appear'd at the extremity of the head, a crook'd part G H, which M. *Leewenhoeck* ſuppoſes to be the inſtrument wherewith it extracts its nouriſhment out of the leaves of the above-mention'd plant.

Fig. 15. K L M N O P repreſents ſome of the blood-veſſels, which partly cover'd another *Animalculum* with ſix legs taken out of the belly of its dam; he likewiſe ſaw amongſt the eggs he had ſeparated from the *Ovarium*, as alſo amongſt thoſe faſten'd to the veſſels of the *Ovarium*, ſuch exceeding ſmall eggs, that 100 of them did not equal a large egg: In all the cochineel-grains M. *Leewenhoeck* had ever examin'd, he found eggs in their bellies, and young ones in thoſe eggs; but in ſome he found more than in others; and in ſuch whoſe bellies were very much ſhrivelled, he found but few eggs; from whence he concluded, that ſuch as had but few eggs in them, had already brought forth a great many young, and that they would not have liv'd long, as happens to all ſmall flies which die ſoon after laying their eggs: Now, foraſmuch, as thoſe *Animalcula* that are found upon lime-trees, *&c.* have young ones in their bellies, even before they come to half their growth; M. *Leewenhoeck* in order to ſee whether it was ſo likewiſe with the cochineel-flies, took eight of the ſmall ones, which he judged did not all together exceed a large grain, ſuch as is repreſented by A B Fig. 7; and ſteeping them over night in rain-water, next morning he found but five that had ſubſided, the other three being ſo light as to ſwim upon the water, which conſequently, had not penetrated thro' them; out of the firſt of theſe ſmall grains that he diſſected, he took 11 eggs; in ſome of which the *Animalcula* were ſo completely form'd, that he could eaſily ſee their legs, beſides ſeveral exceeding ſmall eggs; in the ſecond he could meet with no eggs that were arriv'd to their full growth; out of the third he took three perfect eggs; in the fourth there were none perfect; in the fifth there were two perfect eggs, tho' ſtill leſs; from theſe obſervations he concluded, that the production of the cochineel-flies happens in the ſame manner with that of the *Animalcula* upon the lime, currant, plumb and haſel-trees.

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As to what the *Spaniard* ſaid farther, that the cochineel-flies are ſtifled with ſmoak, as ſoon as they have gather'd wings, becauſe the cochineel is beſt then, this is not at all ſurpriſing; becauſe, when the ſaid flies are arriv'd at their full growth, their bodies are at that time moſt full of eggs; from hence, M. *Leewenhoeck* ſuppoſes, is chiefly deriv'd that noble ſcarlet colour; tho' he affirms, that moſt of the cochineel-flies (as far as he could obſerve) are kill'd or ſmother'd before they arrive at their full growth: The *Spaniard* does not tell us, whether they gather the cochineel once or twice a year; the rather, becauſe the iſlands of *Cuba*, *Hiſpaniola* and *Jamaica*, from whence it moſtly comes, have little or no winter, in compariſon of our countries; for thoſe iſlands lying between 18 and 23 degrees of N. Lat. the ſun in their winter is 40 degrees above the horizon; whereas, with us at the ſame time it is but 14 degrees and a half: If we had as much ſummer as the aforeſaid iſlands, the *Animalcula* which we call a ſort of louſe, would ſo greatly endamage the currant trees with their filth, that there would be no eating the fruit; and yet, according to all appearance, the cochineel-flies are more prolific than theſe are: The cochineel-flies, in all probability dwell upon the back or under ſide of the leaves, which defend them from the great heat of the ſun in thoſe parts; and as the ſmoke cannot deſtroy all thoſe flies, the few that remain multiply very much in a ſhort time: M. *Leewenhoeck* had got about a ſpoonful of powder or duſt, together with ſome ſand out of a cochineel box, and he found, that that which appear'd to be nothing but duſt, was a great number of very ſmall cochineel-flies, ſome of which were ſo minute, as if they had been juſt hatch'd, and ſome were gradually bigger than others; there were, beſides other ſmall particles which he took to be the excrement of the *Animalcula*; he alſo ſaw a great many legs with three joints, ſome that had but two, and a few one joint only; among theſe legs, ſome had claws, which were either white, dark colour'd, or of a light red; he moreover ſaw ſome particles, which he judged to be the heads of the *Animalcula*; and likewiſe other particles of a beautiful red colour, which he ſuppos'd to be the upper parts of their bodies; in the ſaid duſt there were alſo ſome few pointed inſtruments, or rather prickles, no thicker than a ſingle hair of ones head, amongſt which there were two or three that were four times thicker than the reſt; and theſe M. *Leewenhoeck* ſuppoſes to be the ſharp prickles, wherewith (as the *Spaniard* tells us) the leaves are armed, becauſe ſome of them were of a bright, others of a darker yellow.

Fig.

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Fig.

Fig. 16. QRS repreſents one of the ſaid prickles guarded with a vaſt number of teeth about it like ſaws, and no thicker than a hair of the head.

M. *Leewenhoeck* could perceive, but with great difficulty, ſix legs in ſome of the *Animalcula* he had extracted out of the abovemention'd eggs, diſpos'd in ſuch exact order, as may be obſerv'd in the *Aurelia* of a ſilk-worm; the reaſon why he could not diſcover their legs but with difficulty, was, becauſe the *Animalcula* whilſt they were in the egg, were of a dark red colour, and not at all tranſparent, eſpecially, ſuch as were almoſt come to their full growth; at the ſame time he diſcover'd, that the unborn *Animalcula* had two horns, in which at one time, he reckon'd five joints, and another time he thought he ſaw more: After theſe obſervations, to wit, that the cochineel *Animalcula* are not changed from worms to flies, M. *Leewenhoeck* rejects his former poſitions; *viz.* that the cochineel-flies have no ſhields, wherewith they cover their wings; for he had diſcover'd amongſt the cochineel-grains little black ſhields or *Vaginæ*. with a ſmall round red ſpot on each ſhield, which he ſuppoſes to be the ſhields of the flies; the *Animalcula*, whoſe wings are cover'd with ſhields are all of them produced either in earth or in wood, from whence they receive their nouriſhment and growth; and had not nature made this proviſion for them, after they are changed into flying animals, they could not dig out their way, without hurting their tender wings; for M. *Leewenhoeck* having found amongſt the cochineel-grains, one of the aforeſaid ſhields on the hinder part of an *Animalculum*, and viewing the ſame more narrowly, he ſaw plainly, that that trunk or hinder part had no ſimilitude with any of the other grains; now, ſeeing that all animals from the beginning are made to produce their like, if the young cochineel-flies had been furniſhed with wings, it would have been in vain, for the reaſons above-mention'd; tho' indeed, it is neceſſary they ſhould have wings, as ſoon as they are full grown.

M. *Leewenhoeck* having ſent his friend at *Amſterdam* a duplicate of what he has related here, as alſo a copy of the above figures; his friend return'd him an anſwer, wherein he ſays, that he had alſo taken 200 particles out of a cochineel grain; but that he could not after the niceſt obſervations, diſcover any *Animalcula* in the eggs, *&c.* wherefore he concluded, that what M. *Leewenhoeck* calls blood-veſſels, are analogous to the ſame parts which we find in cherries, grapes, *&c.* and that what he takes for the ſhell or membrane of the egg, are only the ſkins that cover

cover the ſeed; now, tho' M. *Leewenhoeck* was entirely ſatisfied, as to his own particular, with the account he had given, and with the figures taken of the cochineel-grains; yet he diſſected ſeveral others of the largeſt ſort, and took the *Animalcula* out of the egg-ſhell, and placed them before divers glaſſes in ſuch order, that he could not only diſtinctly ſee the body of the *Animalculum*, with its parts divided into ſeveral circles, but likewiſe the two horns, with the joints wherewith nature has provided all theſe unborn *Animalcula*, were as plainly viſible.

Fig. 17. A B C D E ſhews the body of the ſaid *Animalculum*, B H, D I and D K the four legs, the two other being hid from the ſight, E F repreſents one of the horns, of which he had a very fair view; the other horn A G was not placed in ſo convenient a light, and conſequently, it is not ſo well delineated; at the extremity of the horns there were three ſmall hairs, which are likewiſe repreſented by F and G.

An Experiment to ſhew the Cauſe of the Deſcent of the Mercury *in the* Barometer *in a* Storm; *by Mr.* Francis Hanksbee. Phil. Tranſ. N° 292. p. 1629.

IN the violent ſtorm or hurricane of wind in *November* 1703, it was obſervable, that the mercury in the barometer did not only conſiderably ſubſide, but upon extraordinary guſts a viſible vibration of the quickſilver appear'd; and for the ſatisfaction of the curious, that high winds can leſſen the preſſure of the atmoſphere, an experiment was made by Mr. *Hanksbee*, giving a demonſtration of this phænomenon; Plate X. Fig. 18. the recipient A containing about five quarts, had about three or four times its natural quantity of air compreſs'd therein by the ſyphon B B, which for that purpoſe, is ſcrew'd on at the bottom, within the ſide of the baſon C; the ſtop-cock D being turned, and the ſyphon taken off, a ſmall ſwan-neck pipe E, is ſcrewed on in its place, that fits into a braſs ſocket, which is fixed in a cubical piece of wood F, right againſt the horizontal pipe G; from the ſame cubical piece F ariſes a naked barometer H H, whoſe ciſtern lies open to the paſſage which leads from the ſwan-neck-pipe to the horizontal pipe aforeſaid; likewiſe from the ſame piece F, there proceeds another pipe or tube I, parallel to the horizon, leading to another cubical piece of wood K, three foot diſtant from the former; out of which there alſo ariſes another barometer L L, whoſe ciſtern is alſo open to the horizontal tube I, and by that means has a communication with the open ciſtern of the other; the parts being

being thus diſpoſed, and the ſtop-cock being turned, the condenſed air proceeds ſtrongly thro' the ſwan-neck pipe, which diſcharges itſelf into the horizontal tube G, whoſe currency diminiſhes the preſſure of the atmoſphere upon the ciſterns of the reſpective barometers, in ſuch a manner as to cauſe the mercury to deſcend two inches at leaſt; and it is obſervable, that that barometer which is three foot diſtant from the current air is equally affected, and ſubſides parallel to the other; it is likewiſe to be obſerved, that as the current air is weakened in its force, the weight of the atmoſphere does again increaſe, and the mercury in the barometer gradually aſcends.

An Account of Eclipſes *of the* Sun *and* Moon, *obſerved at* Cambridge *in* New England; *by Mr.* Thomas Brattle. Phil. Tranſ. N° 292. p. 1630.

ON the 12th of *June* 1694, Mr. *Brattle* went in the morning to the college at *Cambridge*, about four miles from *Boſton*, where he obſerved an eclipſe of the ſun, with a braſs quadrant and teleſcopic ſights, the rays of the ſun being tranſmitted thro' one of the ſaid ſights, on a clean piece of paper, paſſed on a plain piece of board, and faſtened at right angles about a foot diſtant from the ſaid ſight; he had drawn on the ſaid paper a circle between two and three inches diameter, equal to the ſun's diſk, and within that, ſeveral concentric circles, dividing the diameter into 24 equal parts, whereby he could obſerve the eclipſe to ½ a digit; the room where the obſervation was made being darkened with blankets; and to render the obſervation the more exact, and to rectify the watch he took the altitude of the ſun with the aforeſaid quadrant, before the eclipſe began.

	By the Watch		Comp. Altitude		Time by Calculation		Difference	
	h	′ ″		° ′ ″	h	′ ″	′ ″	
At	8	26 37	——	49 31	8	16 40	—— 2	57
	31	27	Mane	48 26	21	40	—— 9	47
	38	26	——	47 20	28	32	—— 9	54

The eclipſe was firſt perceived at 9^h 25′ by the watch, at which time the ſun had ſcarcely been eclipſed a minute, ſo that

At

	By the Watch h ′		True Time h ′	
	9 24	——	9 14	it began
	9 32	——	9 22	about a digit eclipſed
	9 48	——	9 38	full 3 digits
	9 57 ¼	——	9 48	about 4
	10 06	——	9 56	near 5
	10 15	——	10 05	full 6
	10 33	——	10 23	about 8
	10 43	——	10 33	full 9
	10 47	——	10 37	full 9 and ½
	10 53	——	10 43	full 10
	10 59	——	10 49	about 10 and ½
	11 03	——	10 53	better than 10 and ½
	11 06	——	10 56	much the ſame
	11 09	——	10 59	rather decreaſing
At	11 10 ½	——	11 00	½ ſenſibly decreaſed near ¼ of a digit
	11 14 ½	——	11 04	½ neareſt to 10 digits
	11 25	——	11 15	full 9 digits, *i. e.* full 3 digits reſtored, or the ſhadow rather within 9
	11 29	——	11 19	8 digits and ½ compleat
	11 34 ½	——	11 24	½ full 8 digits
	11 44	——	11 34	full 7
	11 48	——	11 38	full 6 and ½
	11 52 ½	——	11 42	½ juſt 6
	0 02 ½ P. M.		11 52	½ juſt 5
	0 13	——	0 03 P. M.	full 4
	0 26	——	0 16	full 2 ½
	0 32	——	0 22	better than 2
	0 41	——	0 31	better than 1
	0 48	——	0 38	ended.

Obſervations made of the ſun's altitude after the eclipſe, in order to rectify the watch.

	Time by the Watch h ′ ″		Comp. Altit. ′ ″		True Time h ′ ″		Differ. ′ ″
At	3 31 30	——	45 52	——	3 21 36	——	9 54
	36 15	——	46 23	——	26 16	——	9 59
	38 10	——	P. M. 46 45	——	28 16	——	9 54
	46 50	——	48 19	——	36 48	——	10 02
	48 10	——	48 30	——	38 20	——	9 50

Hence it appears that the watch went about 10 minutes too faſt during the whole eclipſe, as has been allowed all the way; ſo that the eclipſe began at 9^h 14′ Mane; ended at

0^h 38′ P. M.; laſting in all 3^h 24′; obſerve, that in the calculation, the latitude of *Boſton* was allowed to be 42° 25′.

There happened a lunar eclipſe on *February* the 11th 1700, in the evening, as follows; the moon roſe eclipſed, and the horizon was ſo overcaſt, that Mr. *Brattle* deſpaired of having any obſervation, but at half an hour paſt 6 ſhe came from under the cloud; and at 6^h 25′ he had juſt a ſight of her, and he judged her to be eclipſed about 5 digits at

h.	′	
6	29	The ſection was equi-diſtant from *M. Ætna* and *Horminius.*
	32	*Palus Maræotis* began to appear.
	34	½ *Palus Maræotis* and *Mons Apollonius* half out.
	37	½ *Palus Maræotis* quite free; and *Palus Maræotis* and *Palus Mæotis* in the perpendicular.
	42	¾ The Shadow near an inch from *Palus Maræotis*, *Mons Horminius* and *Mons Hercules.*
	46	¼ *Palus Maræotis* was in the nadir, and that part of *Palus Mæotis* to Mr. *Brattle*'s right-hand was in the prime vertical.
0	57	The upper part of the ſection is now and had been for a long time in *Inſula major in Mari Caſpio* (and the ſection now perpendicular) and the lower part wheeling about from *Palus Maræotis.*
7	20	Mount *Sinai* firſt appeared at 22′ wholly free.
	25	½ *Palus Maræotis* and *Mons Horminius* nearly perpendicular.
	43	The eclipſe was over in the teleſcope, and at
	49	To the naked eye.

Mr. *Brattle*'s clock was ſet by his ring-dial about 9 o'clock in the morning, as exactly as he could judge; and the obſervation was made with his 4½ foot teleſcope, with all the four glaſſes in it.

The obſervation of the eclipſe of the ſun, on the 27th of *November* 1703, was as follows:

At half an hour paſt 8 in the morning, Mr. *Brattle* ſet his clock exactly by his ring-dial; and at ½ an hour paſt 9 they exactly agreed at,

h ′
10 00 The ſun was not touched.
00 06 The moon entered on the S.S.W. point as near as he could judge.
15 The eclipſe was conſiderably advanced.
20 Seemed to be about ½ a digit eclipſed, rather more than leſs, and the ſection a ſmall matter more weſtward.
10 25 Much the ſame, and near the ſame point.
30 Seemed to be leſs.
33 ½ The middle of the ſection nearer the S. W. and the diameter of the ſection leſs every way.
37 ½ Much leſs and nearer the weſt.
44 ½ It ended and was juſt over, going off near the S.W; ſo that all the while it was within a point or two of the place where it firſt came on, or between the S. S. W. and S. W.

Mr. *Brattle* judged when the eclipſe was at the height, that the chord of the eclipſed part was nearly equal to the ſide of an inſcribed decagon, or ſubtended about one tenth of the periphery of the ſun's diſk; he obſerved this eclipſe with a teleſcope of one joint, four foot and a half long; and he had only two glaſſes ſo that it inverted the object; and he had a red glaſs, which he could ſcrew in juſt before the eye-glaſs, without being obliged to hold it in his hand, as when he obſerv'd the ſun's altitude with a braſs quadrant.

An obſervation of the eclipſe of the moon, on *December* the 12th 1703 in the morning.

Time by the Clock.

h ′
11 45 That part of the moon's diſk near *Alabaſtrinus* looked ſomewhat duſkiſh, and the eclipſe began to enter between *Palus Maræotis* and *Mons Porphyritis*.
11 53 The true ſhadow was well entered.
58 *M. Porphyritis* juſt covered.
12 03 ½ Near three digits darkened.
7 ½ Mount *Ætna* began to be darkened.
9 ½ Quite covered.
14 ½ *Lacus niger major* and *M. Sinai* almoſt equi-diſtant from the ſection of the ſhadow, *Lacus niger major*, being ſomewhat the nearer of the two.

h ′
18 ¼ *Lacus niger major* began, and at 19 ½ was quite covered.
21 ¾ Mount *Sinai* began to be covered.
21 ¾ Quite covered, and the moon about 6 digits eclipſed.
12 24 ½ *Besbicus* began to be covered.
26 Quite covered.
28 ¾ *Byſantium* began to be covered.
29 ½ Quite covered; and Mount *Horminius* began to be covered.
32 *Apollonia* began.
33 Quite covered.
37 The ſhadow was equi-diſtant from Mount *Corax* and Mount *Paropamiſus*, or ſomewhat nearer to Mount *Corax*.
39 ½ Between 9 and 10 digits of the moon were eclipſed.
43 M. *Corax* began to be covered.
44 ¾ *Palus Mæotis* began, and at 45 ¾ the inner part of M. *Paropamiſus* began.
50 *Palus Mæotis* quite covered.
51 ½ The moon not quite eclipſed.
52 Nor yet.
53 Nor yet.
54 Scarcely yet.
54 ½ Quite immerged and the *Mora* began.
14 39 Preciſely; and ſhe immerged between *Palus Maræotis* and *Mons Porphyritis*.
42 *Palus Maræotis* began to be free.
43 Quite clear.
47 M. *Porphyritis* quite clear.
55 About 3 digits reſtored.
00 59 Mount *Ætna* began to be clear.
15 02 That and *Lacus niger major* at the ſame time clear.
8 ½ Mount *Sinai* about half free.
9 ½ Quite free, and about 6 digits of the moon reſtored.
30 ½ *Mons Hercules* was free.
32 ¾ *Palus Mæotis* began to be clear.
38 ½ It was quite free.
41 ½ *Inſula major* in *Mari Caſpio* free, and in the middle of the ſection.
42 ½ Not yet wholly clear.
45 Fully over in the telleſcope, tho' a kind of a ſmoak appeared ſome little time after to the naked eye.

In

In order to adjuſt the time, Mr. *Brattle* ſet his clock the preceeding morning with the greateſt exactneſs he could, both from his ring-dial and from the riſing of the ſun, which he watched and obſerved very narrowly; and he found it to agree with the ſun's ſetting the following evening; ſo that it went during all the time of the eclipſe, very ſteadily and regularly; but for the greater certainty and ſatisfaction, he took the altitudes of the following ſtars with the braſs quadrant with telleſcope ſights, out of his chamber window, the lowneſs of which would not permit him to take them at all, when they were elevated higher.

In dextro humero Orionis.

By the Wat.		Comp. Alt.		Time by cal.			Differ.		
h	′	°	″	h	′	″	′	″	
6	6	78	18	6	13	40	1	20	
6	21 ½	77	03	6	20	28	1	02	
	26 ¼	76	11	6	25	08	1	07	*So that by theſe obſervations his clock went nearly a minute too faſt.*
Procyon									
8	9 ¼	77	20	8	08	04	1	11	
	14 ½	76	20	8	13	32	0	58	
	21	75	13	8	19	36	1	24	
Regulus									
10	8 ½	77	46	10	07	18	1	12	
	17 ¼	76	11	10	15	58	1	17	

Mr. *Hodgſon* made ſome obſervations of an eclipſe of the moon, on the 11th of *December* 1704, whereof he gave an account in a former *Tranſaction*; as follows, the heavens being cloudy the moſt part of the night, it was 35′ after 4 in the morning following, before he could perceive that the moon was eclipſed; and then as near as he could judge, ſhe had been ſo about 3 or 4 minutes at moſt; from whence we may conclude, that it began at *London* about 31 or 32 minutes after 4 in the ſame morning.

Mr. *Brattle* found, that at 44 minutes after 11 at night, part of the moon's diſk looked ſomewhat duſkiſh; and that at 52 minutes, the ſhadow was well entered; ſo that from hence, as well as from a compariſon of the ingreſs and egreſs of the principal ſpots; Mr. *Hodgſon* concludes, that probably it began there about 49 minutes after 11, and conſequently that *Cambridge* in *New England* lies $4^h\ 42' \frac{1}{2}$, or $70^\circ\ 37'$, to the weſtward of the meridian of *London*.

Mr.

Mr. *Hodgſon* happened to ſee the moon the ſame morning at 35 minutes after 5, when ſhe wanted at moſt but 3 minutes of being totally eclipſed; ſo that at *London* ſhe immerged at 38 minutes paſt 5.

Mr. *Brattle* ſaw her immerge exactly at 54 minutes after 12; whence it follows, that the difference of the meridians found by comparing theſe obſervations, is $4^h\ 43' \frac{1}{2}$, or $70^\circ\ 52'$, agreeing very well with the former; ſo that by taking a mean between them, the difference of longitude of the two places is $4^h\ 43'$, or $70^\circ\ 45'$; Mr. *Hodgſon* ſaw no more of the eclipſe that morning; and he from hence concludes, that the mutual agreement of theſe obſervations gives great reaſon to believe that the deductions are good, and may be relied on.

Concerning the Fleſh *of* Whales, cryſtalline Humour *of the* Eyes, *&c. by M.* Leewenhoeck. Phil. Tranſ. N° 293. p. 1723.

M. *Leewenhoeck* had often concluded, that the globules of blood (which are the cauſe of its redneſs) are of the ſame magnitude both in large and ſmall animals; and conſequently that the particles of blood in a whale are of the ſame ſize with thoſe of other fiſhes; but not being able to get at any whale's blood, he was obliged to acquieſce in bare ſpeculations; from the particles of blood in a whale, he was led to conſider thoſe of the fleſh, imagining that the fleſhy particles of the ſaid fiſh were no bigger than thoſe of a horſe or cow; and that the bulk of a whale conſiſted only in the great number of its particles; M. *Leewenhoeck* having cut a-croſs a piece of whale's fleſh, (that was brought him by ſome concerned in the *Greenland* fiſhery) in order to ſeparate the particles lengthwiſe; he could diſcover no difference, as to appearance, betwixt the ſaid particles and thoſe of a large ox; the reaſon why he compares a whale with a large ox is, becauſe he takes the fibres in a large ox to be no more in number, than thoſe of a ſmall one; nay even in a calf he ſuppoſes the fibres are not fewer in number, only they are not ſo large.

M. *Leewenhoeck* had the cryſtalline humour of two whales, a large and a ſmall one. Plate X. Fig. 19. A B repreſents the ſmaller cryſtalline humour, when it came to his hands, tho' he ſuppoſes, it was ſomewhat larger when taken out of the whale's eye; for, he obſerved, when he took the cryſtalline humour out of a cod's eye, and laid it down never ſo gently, by reaſon of its ſoftneſs, ſome of its ſubſtance fell out, which having viewed with his glaſſes, he could ſtill diſcover therein the fibrous matter of

of which it conſiſted; in examining the ſaid cryſtalline humour, (which the ſea-faring people miſtake for the whole eye, and ſo ſhew it for an uncommon ſight, that ſo large an animal ſhould have ſo ſmall an eye) it appeared to him, that the fibrous matter or particles whereof it was compoſed, were ſo very thin, making ſuch exceeding fine ſcales, that lay ſo very cloſe upon each other, that it was a ſurpriſing ſight; and this fibrous ſubſtance is thinner of particles than that of a perch not a year old; the reaſon why the fibrous matter of the cryſtalline humour of a ſmall perch appears thicker than that in a whale is, becauſe we ſee the former on one ſide, where the threads or fibres are thickeſt; but if we view them where the fibrous particles meet together, they are exceeding fine and ſlender; whereas, on the contrary the fibrous matter of the whale not meeting together, but often croſſing is of the ſame thickneſs throughout: M. *Leewenhoeck* diſcovered, that the cryſtalline humour in a whale, is of a quite different texture or circumvolution from the fibrous matter in ſeveral animals; for whereas, the ſaid humour in others conſiſts of three particular conjoined branches, all ariſing from one point, the ſame humour in the eye of a whale is compoſed of five circumvolutions all which unite in one point, and make one ſcale; but here M. *Leewenhoeck* only means the half of that orb of the cryſtalline humour which fell immediately under his obſervation.

Fig. 20. CDEF ſhews a ſmall particle of the cryſtalline humour of a whale's eye, taken off from the globular part; the largeneſs of which as it appear'd to the naked eye, is repreſented by GH in Fig. 21; and when he diſſected the ſecond cryſtalline humour as in Fig. 21, he could very eaſily perceive the exact circumvolution and texture of the fibres, notwithſtanding the ſcaly particles were dried together ſo hard, that they were as clear as glaſs; the abovementioned little particle repreſented by Fig. 20. CDEF appear'd to the naked eye no bigger than IK Fig. 22. in which, with his microſcope he could diſcover the exceeding fine threads, which he calls the fibrous matter, with a part of the circumvolution, which compoſe a fifth part or diviſion of the hemiſphere of the ſaid cryſtalline humour; theſe ſcaly particles lying no thicker on each other, than the threads or fibrous matter as repreſented in Fig. 20, how cloſely muſt they then be united; for otherwiſe, it would be impoſſible for the cryſtalline humour, to have ſuch a tranſparency, as the nature of that body requires: In order to give a clearer idea of the texture of the fibres in the cryſtalline humour of a whale's eye, which lie in ſo many folds upon each other, M. *Leewenhoeck* took a common ball, and dividing

viding it into ſuch parts as are analogous or correſpond with th diviſions of the fibrous matter in the cryſtalline humour, he the wound it round with a ſingle ſmall thread, which was to repre ſent the fibrous matter that compos'd a ſmall ſcale of the ſai humour.

Fig. 23. ABCDEFGHIK repreſents the globe or orb o the cryſtalline humour of a whale, whereof L is the center o axis, and lies next to view, where the fibrous particles ariſe ou of the ſhorteſt circumvolution of the oppoſite part of the globe the courſe of which is in ſome meaſure ſhewn by the letters LA LC, LE, LG, LI; as for the fibrous ſubſtance which here firſ circumvolves from the middle point or center, *viz.* QB, PD OF, NH, and MK, they deſcribe the ſame circumvolution in the oppoſite part of the ſphere or globe, which is here repre-ſented by L.

Fig. 24. RSTU repreſents the ſaid ball ſo well wound up in the ſingle thread, that there only appear'd the two extremities of the ſaid thread, and hardly any of the leather of the ball; the center or axis which in Fig. 23. is repreſented by L, where the fibrous matter circumvolves five ſeveral ways, as ALC, CLE, ELG, and GLI we muſt ſuppoſe to be repreſented in this figure by R and T: Here the unconceivable wiſdom of the great Creator of all things is very obvious; for what man is there in the world, that could wind a ball or globe about with a ſingle thread of equal ſize throughout, and not croſs it in any point, as is the caſe in the contexture of the filaments, of which the ſcales of the cryſtalline humour of a whale are compos'd.

M. *Leewenhoeck* having carefully obſerv'd the eyes of ſeveral fiſhes, and particularly the *Tunica cornea*, he found that the ſaid tunic, or rather the pupil or apple of the eye, was very flat, like thoſe in human, and other animals; from whence he concluded, that tho' the cryſtalline humour in fiſhes was ſpherical, yet that was compenſated by the flatneſs of the apple of the eye; conſequently, one might probably conclude, that the eyes of fiſhes are of the ſame contexture with other land-animals, and that the effects in both are the ſame; for the *Tunica cornea* in men makes a circle, whoſe axis is an inch long: Upon taking the eye out of the head of a live cod-fiſh, and putting the *Tunica cornea* into ſeveral copper globes, it appeared to M. *Leewenhoeck*, that the protuberant roundneſs of the ſaid tunic, was equal to the ſegment of a circle, whoſe diameter is two inches; the eye was a little prominent out of the head, like thoſe of other animals; and tho' the tunic or apple of the eye in other animals forms a larger circle,

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circle, yet it is not bigger; M. *Leewenhoeck* found that the axis of the cryſtalline humour in the ſaid cod-fiſh was a little longer than $\frac{1}{3}$ an inch; now, if the cryſtalline humour (which he has ſometimes call'd the cryſtalline muſcle) in our eyes, and in thoſe of ſeveral other animals, conſiſts of a flattiſh roundneſs, and not perfectly ſpherical; and if the diameter of the circle form'd by the tunic of the ſaid eyes be an inch long; the cryſtalline humour in fiſhes being ſpherical, and their tunic deſcribing a circle, whoſe diameter is two inches, all theſe eyes may have the ſame effect: After this M. *Leewenhoeck* took a whiting, which weigh'd about nine ounces, and examining its eye, he found that it deſcrib'd a circle of one inch and a half in diameter; and the diameter of its cryſtalline humour was very near $\frac{1}{3}$ of an inch: When he diſſected the cryſtalline humour of a ſmall fiſh, and found the innermoſt part thereof no bigger than a large grain of ſand, he obſerv'd that the fibrous particles, of which thoſe exceeding ſmall ſcales were compos'd, did conſiſt of as many parts as the uppermoſt ſcales of the ſame humour.

A certain gentleman aſking M. *Leewenhoeck*, why nature had furniſh'd us with eye-lids, ſeeing that fiſhes have none; he anſwer'd that it was abſolutely neceſſary for us, and all land-animals to have eye-lids; for if it were not ſo, and that the apples of our eyes were not moiſten'd ſeveral times in the ſpace of an hour; and all the filth that might fall thereon, waſh'd away, our ſight, or the *Tunica cornea* would be ſo clogg'd, that we ſhould not be able to uſe our eyes; beſides, the ſaid *Tunica* would otherwiſe be parch'd or ſhrunk up with heat, and conſequently we ſhould become blind; whereas, on the contrary, fiſhes always living in water want no eye-lids, becauſe, the ſame water keeps their eyes ſtill moiſt and clean; but M. *Leewenhoeck* had ſince found, that he was miſtaken in his aſſertion; for, flounders, plaice, ſoles, and he believes all flat fiſhes can cover their eyes; and if they could not, he ſuppoſes they would loſe their ſight, becauſe, the ſaid ſort of fiſh are not ſo nimble as others in ſwimming, being only able to move their tails, their chief inſtrument of ſpeed, upwards and downwards; wherefore, theſe fiſhes in a ſtorm do not betake themſelves to the bottom of the ſea, as he was inform'd, but dig themſelves holes in the ſand, which ſecures them from being thrown upon the beach or ſtrand; now if they had not eye-lids, the ſharp points of ſand, whilſt they are making their beds, would wound the tunics of their eyes, whereby the tranſparency thereof would be deſtroy'd, and conſequently theſe

fiſhes would become blind; which is an additional proof how perfect every creature is in its own ſpecies.

The Tubes or Canals that convey the yellow Sap in Aloes-leaves; *by the Same.* Phil. Tranſ. N° 293. p. 1730.

M. *Leewenhoeck* firſt obſerv'd the external ſkin or membrane of the leaves of aloes, to diſcover if poſſible, of what tubes or pipes they were compos'd; but he could not find out the conjunction of the parts; becauſe, that membrane was ſo weak and tender, that it always broke without any remarkable diſcovery; in this diſquiſition M. *Leewenhoeck* obſerv'd, that there lay in the ſaid membrane roundiſh particles, that look'd like little bladders; and in theſe bladders there were green particles, containing a ſap in them, and they lay as it were in a right line, and ſo interwoven with each other, that they ſerv'd as he ſuppos'd, for tubes or canals; the impreſſions of theſe round particles were in ſeveral places ſo regular, that each conſiſted of ſix ſides, diſpos'd in the exacteſt order imaginable; and in each particle might be diſcover'd a protuberance; and they were ſeparated from each other by rings or circles, which he ſuppos'd to be the canals.

Plate X. Fig. 25. A B C D repreſents a ſmall part of the ſaid hexangular particles, as they appeared thro' his microſcope; where ſome of the canals are, to diſtinguiſh them the better, ſhewn outwards as at A B C D; upon farther examining the aloes-leaf, he diſcover'd another ſort of canals or veſſels, in which the ſap appear'd ſomewhat reddiſh; he took the ſap out of the ſaid veſſels, to try whether there were any ſalt particles therein, and what figure they were of; he let this ſap lie a little, that ſome part of it might evaporate, and that the ſalts might coagulate, and placing ſome of it before his microſcope, he obſerv'd a great number of long ſlender particles, that lay in the ſap, and were ſharp or pointed at both extremities; and foraſmuch, as he ſuppos'd, that theſe long particles could not be coagulated in ſo ſhort a time as the ſap had been preſs'd out of the canals, but rather that they were there before, he endeavour'd to bring the ſaid long particles out of the veſſels, ſo as that there ſhould come but very little ſap with them; which happening accordingly, a few of them are repreſented in Fig. 26. E F G H; the ſaid ſlender particles appear'd thro' the microſcope very clear and tranſparent; he laid them upon a clean glaſs-plate, and viewing them about three weeks after, he was ſurpris'd to ſee that ſome of them had aſſum'd a peach-colour, eſpecially ſuch as lay looſe, or upon each other;

after

after ſeveral obſervations, by breaking and cutting into pieces the aloes-leaves, he not only placed ſo nicely before his glaſſes the aforeſaid long pointed particles, that they could be ſeen lying in thoſe rings or circles, which he ſuppos'd ſerv'd for canals, as in Fig. 27. IKLM, in the middle of five rows between I and K; but he alſo ſeparated a ſmall piece of the leaf in ſuch a manner, that the extremities or points of thoſe ſharp particles ſtretch'd themſelves beyond the canals, as is here repreſented in N and O; theſe ſharp particles lay within a ſmall compaſs, like little bundles, as is ſhewn in the figure; but they do not all lie in ſuch order, nor always ſo cloſe to each other; but in ſeveral places at a greater diſtance, and ſometimes indeed cloſer; it is to be obſerv'd, that Fig. 27. IKLM, as it appear'd to the naked eye did not lie in a greater compaſs, than a large grain of ſand; from whence we may conjecture, what a vaſt number of ſuch particles are included in one aloes-leaf; in each of theſe particles in this figure are a great many parts, which ſeem to be canals; and moreover he ſuppoſes, that each circle, or the membranes thereof, in which the ſap and other parts are ſhut up, are alſo full of canals.

Fig. 28. ABCDEFGHI repreſents one of the veſſels or canals, which lie ſomewhat deeper in the leaf, and are in a manner ſurrounded and involv'd in a ſort of viſcous or ſlimy matter, which M. *Leewenhoeck* endeavour'd to ſeparate from it; from theſe veſſels or canals in four diſtinct places (and all in a very little compaſs) there iſſu'd a kind of branches; as two between DE and FG, and two between HI, which run a-croſs from the leaf; theſe twigs or branches unite again in one vein or canal that lies juſt by them, which is not near ſo large as the firſt mention'd canal; and this union or conjunction is repreſented by KLMNO PQR, and there are three ſuch ſmall canals to a large one; yea, the ſaid vein or canal that runs a-croſs, is not only join'd to a ſecond aſcending vein, which extends itſelf the length of the leaf, but it goes farther and falls into a third canal, which alſo runs the length of the ſaid leaf, as may be ſeen in the ſame figure by STVWXYZ*a*; and who knows, if one could inveſtigate the conjunction of the veſſels, but that this order runs thro' the whole leaf; M. *Leewenhoeck* ſuppos'd, that ſome of theſe veins or canals were compos'd of long particles, that extended themſelves in parallel lines, and very near each other, but in a winding and ſerpentine manner; to the end that the ſaid veins might never fall in with each other, but always remain open and diſtinct; and agreeably to this opinion, he ſometimes but very ſeldom, took thoſe parts out of the canals; in the ſaid Fig. WBCDEFX

repreſents the laſt mention'd particle, which compoſes a canal, but of a very ſmall length, and it ſeems to be of a flattiſh ſhape, as between W and B; but viewing it more narrowly he found that the ſeeming flatneſs was occaſion'd by the canals lying ſo cloſe to each other; for he plainly ſaw that B when ſtretch'd out, was two diſtinct canals, as in BCF; and that one of theſe canals was again ſubdivided into two more, as from C to D; and perhaps theſe ſlender particles D and E were further ſubdivided; now a perſon cannot ſee theſe laſt mention'd parts by cutting the leaf thro', without tearing it in pieces; and then for the moſt part theſe canals with the aforeſaid particles are alſo broken; M. *Leewenhoeck* view'd thoſe winding particles, that lie in the canals or veſſels of other leaves, which are ſo exceeding minute and fine, that it was as much as one could do, with a ſharp eye and a good glaſs, to perceive their ſerpentine meanders: After this, he took that particle of the aloes-leaf, which he had before examined lengthwiſe, and cutting it a-croſs, he view'd it in that poſition, in order to diſcover the orifices of thoſe canals, that in Fig. 28. are repreſented in their whole length by A B C D.

Fig. 29. H I K L repreſents (thro' a microſcope that did not enlarge the object ſo much as that thro' which he view'd Fig. 25, 26.) ſix large tubes, which ſhew themſelves in the laſt mention'd veſſel or canal, in which alſo there are a great many other ſmaller pipes; theſe ſmaller pipes, which are to be ſeen about H, have other croſs canals that iſſue from them, from whence proceed the large internal membranes, with the ſap therein.

Fig. 30. M N O repreſents other canals that were alſo cut a-croſs; and by P Q R in Fig. 31. is alſo ſhewn, how out of the canals ſo divided, the membranes proceed, in which moſt of the ſap is included, and of which the greateſt part of the aloes-leaf is compos'd; and theſe membranes with the ſap lying therein, are ſo clear and tranſparent, that you can ſee nothing but their circles or circumferences, as in Q R S T V W X P; between theſe membranes there are canals, but theſe are very few, with their branches that run the length of the leaf, from whence alſo the membranes proceed; and when he took one of theſe canals ſurrounded with membranes, and the matter ſhut up in them, and ſeparated a little of it from thoſe other before-mention'd parts, and expos'd it to the open air, it preſently after aſſum'd a red colour; whereas, thoſe parts that were involv'd in their membranes, retain'd their colour, which was a little upon the green; this change from green to red, M. *Leewenhoeck* obſerv'd ſeveral times

in

in the eggs of a live crab, which he took out and broke into pieces, and upon viewing them, he perceiv'd that the matter which lay in the egg-ſhells was green; but when he let it dry a little, it preſently turn'd from a green to a red: He cut a-croſs the great canals of another aloes-leaf, which appear'd yellow; as alſo did the ſap which came out of the internal membranes; and upon cutting a ſlip or ſlice of ſuch a leaf, which was as thick as the back of a knife, and laying it upon a clean glaſs-plate, it preſently became of a peach-colour; and ſo did a ſmall drop of the ſap upon the ſame glaſs; which being almoſt dried up, there appear'd ſo many ſalt particles in that little matter, as if the ¼ part of it had been mix'd with a ſhining ſand: He took a little of the aforeſaid ſap, and putting it on his thumb-nail, and letting it dry there, he obſerv'd, that it had left a yellowiſh colour behind it; and that the particles of ſalt had coagulated upon his nail, in the ſame manner, as a foggy moiſture is congeal'd in winter on glaſs-windows; and next day he perceiv'd a reddiſh colour where the ſap had lain; and where it had been thickeſt the red was deepeſt, being what we call a peach-colour; he tried the ſame experiment upon two other nails of his hand, and the ſucceſs was the ſame, and the colour laſted ſeveral days; he cut a little ſplinter of the wood, in which there had been ſome of the aloes-ſap, but where there was at that time but little colour to be ſeen; and placing it before his microſcope, he ſaw that it gradually aſſum'd a peach-colour, which was in ſome places as bright and as fine as ever he ſaw; cutting off a ſlice of the aloes-leaf from its thickeſt part, as ABC Fig. 32. which letters repreſent the ſide of the leaf, that as he ſuppoſes, was next the plant; and CDA the other ſide, which a perſon would take to be the back of the ſaid leaf; that part of the leaf, which we may look upon to be the ſkin or rind, and in which the parts repreſented in Fig. 25, 26, 27, 28, are for the moſt part ſhut up, is the ſpace deſcrib'd in Fig. 32. between BF or DH; and between EFGH lies the abovemention'd ſlimy, or viſcous ſubſtance, in which he could not diſcover any veſſels that run thro' the middle of it, like thoſe which proceeded out of the large canals, and ſpread themſelves to the innermoſt parts of the leaf, and were exceeding ſmall and numerous.

M. *Leewenhoeck* placed another ſlice of the aloes-leaf (which was alſo about the thickneſs of the back of a knife) upon a clean glaſs, and viewing it ſeveral times, being of a fine peach-colour, he obſerv'd therein a kind of oval figure, that lay in an exact order,

order, with its ſap ſhut up in it, after it had been dry about three weeks.

Fig. 33. DEFGH repreſents the ſaid oval membrane; FIG that part he calls the canal, by which he alſo ſuppoſes, that it receives its increaſe and inward matter; in this figure may be ſeen a great many fibres, which he concluded it had borrow'd from other membranes, both from thoſe that lay upon it, as from thoſe that lay under it: Now if we conſider, that theſe membranes cannot be coagulated by the air, ſince they are not form'd by every evaporation, or exhalation of the moiſture; but that ſuch membranes muſt without doubt, be compos'd of a vaſt number of fibres, ſo ſmall as to eſcape our ſight, we have freſh cauſe to be ſurpris'd at the unconceivable wonders ſhut up in ſuch a leaf.

Fig. 31. RPABCSQR repreſents a ſmall particle of what M. *Leewenhoeck* calls the rind or bark of the leaf, as it was cut off a-croſs between D and H in Fig. 32. and dried up irregularly; which part, with SQRPA lay inwards, as repreſented by H in Fig. 32; and in Fig. 31. lay on the outſide of the leaf, as is ſhewn by BC; now theſe parts which in Fig. 31. are cut a-croſs between AB and CS, are the very ſame parts which in Fig. 27. IKLM are repreſented lengthwiſe, only with this difference, that Fig. 31. was delineated from a leſs magnifying microſcope: A perſon would judge that moſt of the above-mention'd parts are compos'd of roundiſh membranes, that include a ſap, mix'd with exceeding ſmall green particles, ſo united with each other, as that there is no intermediate ſpace, excepting that which appears to be canals: He ſqueez'd out ſome of the ſap of the aloes-leaf, and placing it ſeveral times upon his eſcrutore, he always obſerv'd, that when the water was for the moſt part evaporated, there remain'd behind abundance of ſalt particles, which were almoſt all of them of a quadrangular figure, and of a cubical thickneſs, as repreſented in Fig. 34. between IK; and again ſome ſmaller, as in Fig. 35. between LM; and others ſtill ſmaller as in Fig. 36, 37; nay, ſome of them were ſo exceeding ſmall, that they almoſt eſcap'd the ſight, even thro' a microſcope; inſomuch, that a perſon could not judge whether theſe ſalts were round or ſquare; M. *Leewenhoeck* alſo obſerv'd ſome figures of ſalt compos'd of ſeveral coagulated together, in ſuch a manner, that their figure could not be deſcrib'd; and amongſt the reſt there was one ſalt particle compos'd of four others, join'd together like a cube, as repreſented in Fig. 38. between N and O; he likewiſe obſerv'd, another ſalt particle compos'd of 20 qua-

quadrilateral ones coagulated together; to wit, five in length and four in breadth; and in another he reckon'd 30 particles, conjoin'd in the ſame manner: When he took the ſap out of an aloes-leaf, whoſe veſſels contain'd a yellow liquor, he obſerv'd the ſalt particles lie ſo clear, as if they had been little pieces of glaſs; and foraſmuch, as they were ſurrounded with a fine peach-colour, it was a very agreeable ſight.

From his obſervations on the ſaid ſalts, he was led to conſider the aloes itſelf, as it is us'd in the apothecary's ſhops; he took a piece of aloes, and beating it ſmall, he wrapp'd it up in a paper, and putting it into a clean glaſs, he pour'd rain-water thereon, in which he let it infuſe for two or three days; then pouring off the top, and cauſing it to evaporate, he diſcover'd a great number of ſalt particles, of the ſame figure and proportion as thoſe repreſented by Fig. 35, 36, 37, 38; there were alſo coagulated a great many ſalt particles, of the ſame figure with thoſe repreſented by Fig. 26. EFGH, only with this difference, that they were ſomewhat thicker, and ſhorter in the middle; and ſome of them not ſo even or ſmooth as thoſe in the ſaid figure.

M. *Leewenhoeck* had a ſmall plant of *Lapathum ſanguineum*, or dragon's blood, in which he view'd the ſtalk of the leaf after he had cut it a-croſs, and at the ſame time he diſcover'd ſeveral colours of a light, and of a deeper red; and in the ſame ſtalk he obſerv'd little places wherein he could perceive no colour; but upon cutting the ſame ſtalk lengthwiſe, he could then ſee that thoſe places were canals, thro' which he concluded, that the red ſap paſs'd; and that thoſe ſeveral colours, which lay in the canals were a ſort of bags, that contain'd the ſap; and that the ſaid colours were entirely produced by the ſap, that ouz'd thro' the ſides of the canals, and ſo made the whole ſtalk red.

Concerning Tobacco-aſhes; *by the Same.* Phil. Tranſ. N° 293. p. 1740.

A Certain gentleman gave M. *Leewenhoeck* a ſmall quantity of tobacco-aſhes not throughly burnt, and which he had ſav'd out of his pipe; a part of which M. *Leewenhoeck* put into a glaſs-tube, and pour'd rain-water thereon; after he had mix'd it well with the water, and the aſhes had ſubſided, they took up one part of the tube, and the water ſtood two parts more above it; altho' theſe aſhes were of a grey colour, and all the particles thereof appear'd to the naked eye to be entirely burnt; yet he could perceive after mixing the water, that there remain'd ſome exceeding ſmall particles of tobacco, that were not turn'd into the

the colour of these grey ashes; after that the water had stood 24 hours upon the said ashes, he took a little thereof, which to the sight appear'd very clear; but when he observ'd it with his microscope, he saw that it was impregnated with a great many small particles, which were about the same weight with the water, for they neither subsided to the bottom, nor emerged to the surface of the water; he view'd this water with five distinct microscopes, to observe what salt particles were in the water, after it was evaporated.

Plate X. Fig. 39. A B C represents three distinct salt particles, which tho' they were hexangular, and as transparent as if they were made of glass; yet their sides rose into pyramids, just like crystals polished into six sides, all terminating in sharp points, only with this difference, that the superficies of A appeared with six equal sides; but tho' there could be no superficies discovered in B and C, yet that which appeared but with one point, he does not question, might also be hexangular; amongst these salt particles there lay a great many others, wherein by reason of their exceeding smallness, their form or shape was not to be discovered, excepting some of the largest of them, which he could just perceive to be hexangular; and in all his observations he found such particles amongst divers sorts of salts; he also saw a few other hexangular, salt particles, but quite flat, as represented by E F Fig. 40. near which lay another kind of salt, as shewn by G H Fig. 41; he also observed several salt particles like I K Fig. 42. only with this difference, that they had two sharp points at I; he likewise observed several regular square salts, and one also that at first seem'd to be of the same figure; but, upon viewing it narrowly, he found that it had two obtuse angles, as in Fig. 43. L M; there were several other salts, which a person would take for quadrangular figures, seeming to have two long and two short sides; but upon viewing them more nicely, he also found them to be hexangular, as in Fig. 44. N O; other salt particles appeared like equilateral triangles, the angles of which were cut off, and which in one particle appeared larger than in others, as in Fig. 45. P Q; one salt particle represented an oblong cube, as in Fig. 46. R S; he also saw several salt particles, some of which were larger than others, as indeed all the rest of the salts were, which appeared like V W Fig. 47, 48; there were likewise some salts, but very few, that were quadrilateral; and at one extremity the angle was acute, and at the other obtuse, as in Fig. 49. X Y; he likewise observed several long and slender salts, that appeared like Fig. 50. Z Z, which were so closely linked to each other, that

one

one would be apt to take them for one ſingle particle; but viewing them more narrowly, they appeared to be ſeveral linked together: Moreover, M. *Leewenhoeck* tried theſe aſhes three ſeveral times in a ſtrong fire (after he had kept them in a ſmall wooden box) to ſee what volatile ſalts could be extracted from them; and he always obſerved, that firſt a very clear liquor exhaled from the aſhes, which at the laſt evaporation was accompanied with a yellowiſh oil, coagulated in ſuch a manner, as if it was mixed with ſalts; he alſo ſaw a great many ſmall watery particles, which might be called a ſpirit; and a vaſt number of ſmall bubbles, which he judged to be oil, ſome of which were ſo much ſmaller than others, that they almoſt eſcaped the ſight thro' a good microſcope; there were, moreover, on the ſides of the glaſs ſome very ſmall particles, that were neither water nor oil, which he ſuppoſed to be volatile ſalts; but not being able to diſcover any exact figure in them, he can determine nothing certain about them; he likewiſe always obſerved, that when he brought the glaſs where it was covered with the tobacco aſhes, to ſuch a ſtrong fire, as would put it into fuſion, the aſhes, or rather the ſalts thereof, united with the glaſs, and the glaſs aſcended with air bubbles; and with a ſtill ſtronger fire there was a hole made in the glaſs.

M. *Leewenhoeck* took ſeveral times a ſmall piece of *Delft* earthen-ware, which was but once baked, and conſequently not glaz'd; and making a ſmall cavity therein, ſo as to ſerve for a teſt or ſhell, ſuch as the refiners with bone-aſhes uſe, he put into it a little bit of gold or ſilver, together with ſome lead; and ſetting this ſhell upon a large piece of lighted charcoal, ſuch as he judged ſufficient for his purpoſe, and blowing the flame of a lamp thro' a pipe, he made the lead evaporate, but the gold remained behind; yet, it ſometimes happened, that the melted gold or ſilver had made ſuch a deep pit in the earthen ſhell, that he was obliged to make uſe of another, in order to clear it of all the lead; after he had evaporated the above-mentioned lead, he put a little tobacco aſhes into one of theſe earthen ſhells, and in the ſpace of two minutes, with a ſtrong flame of a very thick tallow candle, moſt of the aſhes was turn'd into ſmall globules, and the remainder was in a manner nothing but ſalt; after this, taking three parts of a certain ſmall quantity of the ſaid tobacco aſhes, and proceeding therewith as he had done before, after the ſpace of a little more than two minutes, he took off the ſhell from the fire, and he found that the remaining aſhes weighed a very little more than two parts; and

the colour of these grey ashes; after that the water had stood 24 hours upon the said ashes, he took a little thereof, which to the sight appear'd very clear; but when he observ'd it with his microscope, he saw that it was impregnated with a great many small particles, which were about the same weight with the water, for they neither subsided to the bottom, nor emerged to the surface of the water; he view'd this water with five distinct microscopes, to observe what salt particles were in the water, after it was evaporated.

Plate X. Fig. 39. A B C represents three distinct salt particles, which tho' they were hexangular, and as transparent as if they were made of glass; yet their sides rose into pyramids, just like crystals polished into six sides, all terminating in sharp points, only with this difference, that the superficies of A appeared with six equal sides; but tho' there could be no superficies discovered in B and C, yet that which appeared but with one point, he does not question, might also be hexangular; amongst these salt particles there lay a great many others, wherein by reason of their exceeding smallness, their form or shape was not to be discovered, excepting some of the largest of them, which he could just perceive to be hexangular; and in all his observations he found such particles amongst divers sorts of salts; he also saw a few other hexangular, salt particles, but quite flat, as represented by E F Fig. 40. near which lay another kind of salt, as shewn by G H Fig. 41; he also observed several salt particles like I K Fig. 42. only with this difference, that they had two sharp points at I; he likewise observed several regular square salts, and one also that at first seem'd to be of the same figure; but, upon viewing it narrowly, he found that it had two obtuse angles, as in Fig. 43. L M; there were several other salts, which a person would take for quadrangular figures, seeming to have two long and two short sides; but upon viewing them more nicely, he also found them to be hexangular, as in Fig. 44. N O; other salt particles appeared like equilateral triangles, the angles of which were cut off, and which in one particle appeared larger than in others, as in Fig. 45. P Q; one salt particle represented an oblong cube, as in Fig. 46. R S; he also saw several salt particles, some of which were larger than others, as indeed all the rest of the salts were, which appeared like V W Fig. 47, 48; there were likewise some salts, but very few, that were quadrilateral; and at one extremity the angle was acute, and at the other obtuse, as in Fig. 49. X Y; he likewise observed several long and slender salts, that appeared like Fig. 50. Z Z, which were so closely linked to each other, that one

one would be apt to take them for one ſingle particle; but viewing them more narrowly, they appeared to be ſeveral linked together: Moreover, M. *Leewenhoeck* tried theſe aſhes three ſeveral times in a ſtrong fire (after he had kept them in a ſmall wooden box) to ſee what volatile ſalts could be extracted from them; and he always obſerved, that firſt a very clear liquor exhaled from the aſhes, which at the laſt evaporation was accompanied with a yellowiſh oil, coagulated in ſuch a manner, as if it was mixed with ſalts; he alſo ſaw a great many ſmall watery particles, which might be called a ſpirit; and a vaſt number of ſmall bubbles, which he judged to be oil, ſome of which were ſo much ſmaller than others, that they almoſt eſcaped the ſight thro' a good microſcope; there were, moreover, on the ſides of the glaſs ſome very ſmall particles, that were neither water nor oil, which he ſuppoſed to be volatile ſalts; but not being able to diſcover any exact figure in them, he can determine nothing certain about them; he likewiſe always obſerved, that when he brought the glaſs where it was covered with the tobacco aſhes, to ſuch a ſtrong fire, as would put it into fuſion, the aſhes, or rather the ſalts thereof, united with the glaſs, and the glaſs aſcended with air bubbles; and with a ſtill ſtronger fire there was a hole made in the glaſs.

M. *Leewenhoeck* took ſeveral times a ſmall piece of *Delft* earthen-ware, which was but once baked, and conſequently not glaz'd; and making a ſmall cavity therein, ſo as to ſerve for a teſt or ſhell, ſuch as the refiners with bone-aſhes uſe, he put into it a little bit of gold or ſilver, together with ſome lead; and ſetting this ſhell upon a large piece of lighted charcoal, ſuch as he judged ſufficient for his purpoſe, and blowing the flame of a lamp thro' a pipe, he made the lead evaporate, but the gold remained behind; yet, it ſometimes happened, that the melted gold or ſilver had made ſuch a deep pit in the earthen ſhell, that he was obliged to make uſe of another, in order to clear it of all the lead; after he had evaporated the above-mentioned lead, he put a little tobacco aſhes into one of theſe earthen ſhells, and in the ſpace of two minutes, with a ſtrong flame of a very thick tallow candle, moſt of the aſhes was turn'd into ſmall globules, and the remainder was in a manner nothing but ſalt; after this, taking three parts of a certain ſmall quantity of the ſaid tobacco aſhes, and proceeding therewith as he had done before, after the ſpace of a little more than two minutes, he took off the ſhell from the fire, and he found that the remaining aſhes weighed a very little more than two parts; and

that the ſhell, on that ſide that was moſt expoſed to the fire, was turned into a glaſſy ſubſtance; he put the aſhes thus prepared (which rather looked like petrified matter than aſhes) into a clean glaſs, and poured water thereon; and ſtirring it ſeveral times about with a copper-wire, he let it ſtand 24 hours, and then he decanted off what appeared ſettled and clear to the ſight; of which having put a very ſmall quantity upon a clean glaſs-plate, and viewing it thro' ſeveral microſcopes, he always obſerved in a little time after, a great many coagulated ſalt particles, that were neither flat nor ſlender, but moſt of them as thick as they were long, and almoſt each of them of a particular ſhape, which was a very agreeable ſight; but he found none like thoſe repreſented by Fig. 39, 40, 43; amongſt theſe there lay ſome ſalt particles ſo very ſmall, that he could not diſcover their exact figure, tho' he had uſed never ſo large microſcopes; yet, he was ſatisfied, that they were ſalt particles extracted from the tobacco-aſhes; he alſo obſerved, that upon ſome aſhes which were not mixed with the water, there lay a white ſubſtance, which he imagined to have ſunk and deſcended leiſurely, becauſe it lay higher in the middle, than towards the ſides of the glaſs; and he took this white matter to be coagulated ſalts, which being heavier than the water, had ſubſided upon the reſt, and ſo he found it to be; for when he took it out of the water, and viewed it with the microſcope, he ſaw a vaſt number of ſalt-particles each of a particular figure, and as clear as cryſtal; tho' they appeared ſmaller to his ſight than thoſe which he cauſed to be delineated. Moreover, M. *Leewenhoeck* took a new blown glaſs tube, and putting into it a little of the laſt mentioned water (after it had ſtood three days upon the tobacco aſhes) he viewed it with his microſcope, and ſaw two particles therein, which he ſuppoſed to be ſalts; whereupon, pouring out of the tube a drop of water no bigger than a large grain of ſand (which ſpread itſelf ſo much upon a glaſs-plate, that there did not remain above one fourth part of it that could be ſeen) he diſcovered therein ſeveral long particles, which reſembled very much the hair of the beard of two or three days growth; he diſcovered theſe particles in about the ſpace of a minute; whereas, he ſaw nothing before but a fluid clear water; and after the ſpace of another minute, the ſaid particles were increaſed to the number of 30, ſome of which floated up and down in the little moiſture, and were grown thicker and broader; eſpecially, ſuch as lay at ſome diſtance from the reſt; and ſome were ſo thick and broad, that they far exceeded the others in largeneſs; and when almoſt all the water was evi-

hal'd, he ſaw a great number of very ſmall particles, in which he could diſcover no figure; becauſe all the ſalt particles were ſurrounded with a watry moiſture which did not evaporate: Moreover, he took the glaſs wherein the tobacco aſhes were, that he had reduced to a petrified ſubſtance, and held it over the flame of a candle till the water boiled, for the ſpace of two minutes, when the ſaid ſubſtance was ſeveral times lifted up in the water, expecting that the ſalt particles ſhould be diſſolv'd by the ſaid heat and incorporated with the water, wherein they lay coagulated like cubes, but he could not bring it to bear; the ſalts being link'd by hundreds together, either ſubſiding to the bottom, or ſticking to the glaſs; all theſe coagulated ſalts were ſo ſmall, that let him uſe what microſcope he would, he could not fully diſcover their figures; which however, he took to be hexangular; and the rather, becauſe he ſuppoſed them all to be of the ſame bigneſs; nor could he, as before, ſee one ſalt particle in ſo great a number, bigger than the reſt, tho' the water had ſtood ſome days upon the aſhes; thereupon, he poured the water and the aſhes together from the tube, and cauſed the water to evaporate leiſurely over the fire; and laying the remaining aſhes upon a piece of earthen-ware, he made it red hot; and when it had cooled, he crumbled it to pieces between a piece of paper; then putting it into a new glaſs, and pouring a little water thereon, he expected to find that the ſalt particles would be diſſolved by the force of the fire, and united with the water; whereupon, he renewed his obſervations, pouring off the water leiſurely, to the end that the great number of ſalt particles, in the evaporation of the water, might not coagulate too faſt, and ſo hinder an exact view of them; and he obſerved ſeveral times, that the ſalt particles, tho' exceeding ſmall, were hexangular, as in Fig. 40. E F; but ſome of them were longer than others, and ſome much larger; and ſome again were ſo ſlender, that he could not have ſeen them, had not their circumference been thicker and brighter than the reſt: Hereupon, he again took a little tobacco-aſhes, as clean as they came out of the pipe, and mixing them with pure rain-water, he found the ſame effect in the coagulation of the ſalts as before, tho' amongſt the ſaid figures of ſalt he diſcovered ſeveral others; he concluded, that all that were not hexangular were of another figure, by reaſon of the coagulation, or inclination of the ſalts to each other; which happened more in ſome places of the water than in others; whereby the ſalts aſſumed a figure that was not proper to them: After that the water had ſtood ſix hours upon the tobacco-aſhes, which he had twice put into a glowing

heat, he obſerved a great many cubical ſalts of ſeveral figures, that were coagulated in the water; whereas, he could ſee but two ſuch ſalt particles in the water poured upon the tobacco-aſhes, juſt as they came out of the pipe; M. *Lewenhoeck* made this laſt experiment in very moiſt weather, when the ſalt particles did not only coagulate, but were alſo ſo tenacious of their figure, that he ſcarcely ever obſerved any ſalts extracted from burnt matter, ſo ſtubborn and ſtrong as theſe were: He put the glaſs a ſecond time over the flame of a candle, 'till the water actually boiled, and then viewing it, he ſaw ſome large particles that were very dark, and ſurrounded with abundance of very ſmall particles, whoſe figures he could not diſcover, no more than he could of ſeveral other ſmall particles, which he ſuppoſed to be ſalts.

Cuculus lævis cæruleo-flaveſcens, cui in ſupremo capite bronchiarum opercula; *or the* Yellow Gurnard; *by Dr.* Tyſon. Phil. Tranſ. N° 293. p. 1749.

IF we may juſtly infer the identity of ſpecies in fiſhes, from the likeneſs of their fins, we have then ſome ground to conclude, that this fiſh (the Dr. gives an account of, and which had not hitherto been deſcribed by any) ought to be referred to the gurnard kind; however, the Dr. not finding any other ſpecies it agreed with better, and having no name it was called by where caught, which was about *Haſtings* in *Suſſex*, he takes the liberty to call it the yellow gurnard; and that he had ſome colour of reaſon for ſo doing, will appear, after comparing this fiſh with the red gurnard, and ſhewing wherein they agreed or differed; and firſt of all, as to the general ſhape of their bodies, he found that they agreed well enough; in both, the head was the largeſt part; the body thence ſtill gradually leſſening and becoming more taper, as it approached the tail, where it was very ſmall in both; the yellow gurnard meaſured 11 inches in length, whereof the tail was two inches; the girth of the head was four inches and a half; the fins as to number and ſituation on the body, were exactly the ſame in both; he, therefore only takes notice how they differ in other circumſtances; as in the fore-fin on the back of the yellow gurnard, there were four or five *Radii* or ſpines; whereof the firſt was ſix inches long, and the next about two, the others ſhorter; in this fin in the red gurnard were ſix ſtrong bony ſpines, ſharp pointed, whereof the ſecond from the head being the longeſt, was only a little above an inch, and the reſt not much ſhorter. It is to be obſerved, that the red gurnard the Dr. had to compare with, was but ſmall and ſomething ſmaller than the yellow one;

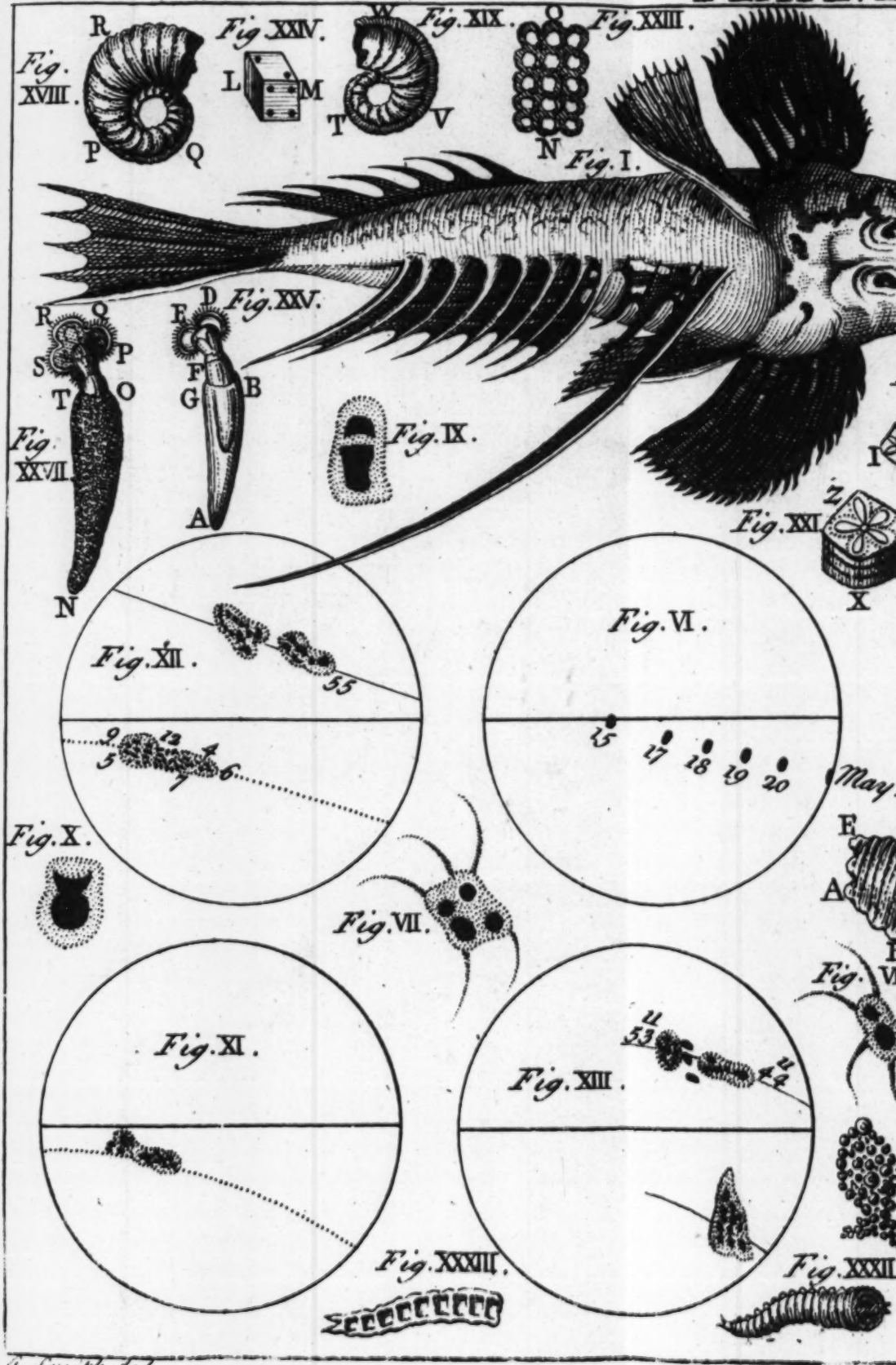
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in the hinder-fin of the back of the yellow gurnard, there were nine *Radii*; in the red gurnard 14; in both, the *Radii* near the tail were the longeſt, thoſe in the yellow gurnard being two inches and a half long; the membrane that joined the *Radii* of the back-fins, differed very much as to colour in theſe fiſhes; for in both the back-fins of the red gurnard, this membrane was all of a white tranſparent colour; on the fore-fin of the yellow gurnard, the membrane was yellowiſh with blue ſpots, and ſome edg'd with black; and the membrane of the hinder-fin was of a faint blueiſh colour, with four yellow liſts or ſtreaks about a line broad, running the whole length; as in Plate XI. Fig. 1. the *Pinnæ bronchiales* (whereof there were two on each ſide, and their ſituation the ſame in both, the uppermoſt being inſerted perpendicular, and the lowermoſt horizontal to the body) differed likewiſe in colour; for in the yellow gurnard the uppermoſt fins were white; the lowermoſt of a dark blackiſh colour, with ſeveral beautiful long ſpots of an azure blue; in the red gurnard the uppermoſt fins were of a dark reddiſh colour, and the lowermoſt white; but here, between theſe two fins he obſered three naked cartilaginous *Radii*, which are not in the yellow gurnard, and are well expreſſed in *Salvianus*'s figure of the red gurnard; the fin on the belly was placed exactly alike in both; here the yellow gurnard had nine *Radii*, and its membrane was of a darkiſh blue colour; here the red gurnard had 17 or 18 *Radii*, and its membrane was tranſparent and white; the tail was much the ſame in both; over the *Anus* in the yellow gurnard there was a ſlender pendulous body, which was not obſerved in the red gurnard; the colour of the bodies of theſe two fiſhes likewiſe differ'd very much; and Dr. *Tyſon* does not know, but that it may be property in this ſpecies to vary in colour, more than any other fiſhes do; the belly of the red gurnard and ſome parts of the ſides near the belly, were of a ſilver colour; the reſt, together with the back and the head, were of a reddiſh colour; in the head there were ſome ſmall whitiſh ſpots; the belly of the yellow gurnard was white, but under the lower jaw black; the ſides and back were yellowiſh; but between the belly and ſides there ran a blue ſtreak, or liſt, about a line and a half broad, from the head to the tail; and a little higher on the ſides, there was a chain of blue ſpots the whole length of the fiſh; for, on the ſides of the head he obſerved theſe blue ſpots, only, that from the eyes to the extremity of the *Roſtrum*, the ſpots were of a deep yellow colour; there being therefore, ſo much blue and yellow over the greateſt part of the body of this fiſh, the Dr. calls it

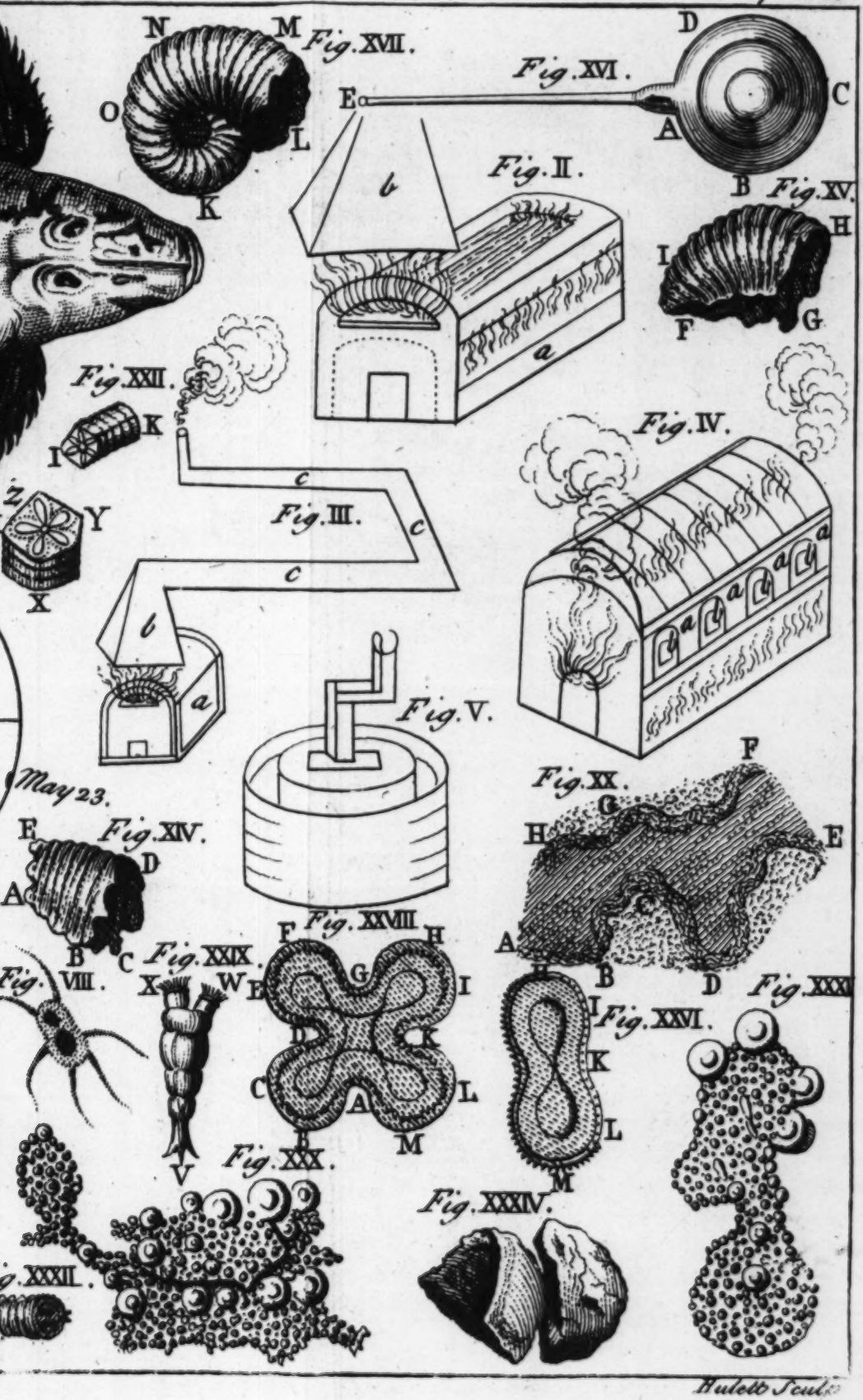
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Cæruleo-flaveſcens; for where the ground is blue, the ſpots a
yellow; and where yellow, the ſpots are blue: Tho' hitherto
there ſeems a tolerable agreement between theſe two fiſhes, y
in the ſubſequent remarks, the diſagreement will appear greater
for the yellow gurnard had no ſcales, and therefore the Dr. cal
it *Lævis*; the red gurnard had ſcales not only on the back, b
likewiſe a ridge of ſpiny ſcales all along the ſides; as alſo o
each ſide of the back there were fins ranged like ſpiny ridges o
ſcales; but the belly ſeemed almoſt ſmooth, having but fe
ſcales, and thoſe very fine; and indeed, thoſe on the back we
much ſmaller than thoſe in moſt other fiſhes; if M. *Leewenhoeck*
obſervation be true; *viz.* that even the anguillous kinds are ſcal
then the difference will not be ſo great, the one having membr
nulous ſcales, and the other bony ones; or it may be, that o
ſubject is an intermediate ſpecies between the gurnard kind an
ſome other; and this the Dr. is more apt to believe, becauſ
tho' it has gills on each ſide, yet it had not thoſe apertures at th
ſides of the head that the red gurnard had, and which is commo
to moſt fiſhes, excepting the cetaceous kinds; but like them, th
yellow gurnard had two apertures, or large *Foraminæ*, placed o
the hinder part of the head, an inch beyond the eyes, at whic
it ſpouts out the water, by blowing into theſe holes; he extende
the cavities where the gills lay, and he obſerved, that over the
cavities there was placed a flat bone, which, by the contractio
of its muſcles, might ſerve to force the water out; and perhap
it is aſſiſted in this action by another looſe bone that lies over i
whoſe edges are jagged, or indented, as repreſented in the figu
at which place in the red gurnard, the Dr. obſerved a ſtron
ſharp ſpine: Theſe *Foramina* in the head of this fiſh is a thin
ſo very remarkable, that it may be looked upon as a characteriſt
thereof; and the Dr. does not know with what other fiſh
compare it; for the cetaceous kinds that have ſpouts in the
heads, have no *Bronchiæ*, but lungs; and therefore, the bett
to diſtinguiſh this fiſh, he has added this particular to i
name.

Dr. *Tyſon* obſerved, that the eyes in the yellow gurnard, we
placed more on the top of the head, and that the ſkin in th
place covered almoſt half of them, like an eye-lid; which h
did not obſerve in the red gurnard, whoſe eyes were placed mo
at the ſides of the head; the head alſo of the red gurnard w
more protuberant, but that of the yellow gurnard flatter; th
extremity of the *Roſtrum*, the teeth, and the tongue in both we
exactly alike; only, that he obſerved in the palate of the yello
gu


Fig. XVIII.
R
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Fig. XXIV.
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Fig. XIX.
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Fig. XXIII.
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Fig. I.
Fig. XXV.
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Fig. XXVII.
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Fig. IX.
Fig. XXI.
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Fig. XII.
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Fig. VI.
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May
Fig. X.
Fig. VII.
E
A
Fig. XI.
Fig. XIII.
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11
42
Fig. XXXIII.
Fig. XXXII.

J. Smith del.



Hulett Sculp.

gurnard two cartilaginous bones, whoſe edges were bended downwards from the palate, and ſerv'd as the Dr. ſuppos'd, for hooking in and ſtaying the cartilage of the tongue, when it makes a compreſſion for forcing out the water by the *Foramina* of the head, which contrivance he did not find in the red gurnard, that fiſh not having the like occaſion for them; the gills of this fiſh had four *Oſſeous radii* of each ſide.

Of Cobalt, *and the Preparations of* Smalt *and* Arſenic; *by Dr.* Krieg. Phil. Tranſ. N° 293. p. 1753.

THE *Cadmia nativa*, or *Cobalt* (of which is made the blue colour, call'd *Smaltum*) is a maſſy, heavy, grey, ſhining ſtone, found in great quantities in the mines about *Schneeberg*, and in ſome other places of *Miſnia*; it is very often mix'd with marcaſite, and ſometimes with ſilver and copper ores; after they have pick'd out the *Cobalt*, and ſeparated it from the common ſtone, they beat it to powder with a *Poch-werk* or ſtamping machine, which is commonly us'd in mines; by that operation, the water carries away the light ſtuff and ſand, leaving the heavieſt parts behind; this powder is afterwards put into a low and broad furnace, made on purpoſe to ſeparate the ſulphur and arſenic, where the powder is ſpread all over; and the fire, which is beneath and behind it, is forced to paſs its flame along, and over the powder, and ſo carry with it the arſenic in form of a ſmoke, which is afterwards receiv'd by a low chimney, and out of that convey'd into a cloſe channel made of brick-work, upwards of 50 paces, where the arſenic ſticks by the way to the wall, in form of a white, or yellowiſh powder, which is taken out every ſix months, and melted into whole pieces: The *Cobalt* being thus roaſted, and ſmoaking a little, is taken out when red hot, cool'd again and gather'd for melting; its colour, by that way of roaſting, becomes a little more whitiſh.

When they have a mind to melt it, the powder of the *Cobalt* is mix'd with pot-aſhes, and powder of white flint ſtones; the proportion of which is, according to the goodneſs of the *Cobalt*; or according as the *Smalt* is to be made of a deeper, or paler colour; for inſtance, they take one part of pot-aſhes, two parts of *Cobalt*, and three or four parts of flint; this mixture is put into large ſtrong pots, ſtanding in a hot furnace, ſix or eight pots in one furnace; where it ſtands melting for five or ſix hours, when it becomes a blue glaſs, which is afterwards taken out with a large iron-ladle, and put into a veſſel full of cold water; where it cracks and becomes more tender, in order to be the more

eaſily

eaſily powder'd again; but the empty pot in the furnace is fill'd up again with the aforeſaid mixture; and thus they continue night and day, ſtill maintaining the fire in the furnace: The blue glaſs taken out of the water is powder'd again by the common engine; the fineſt part being ſeparated by a ſieve, is put into a mill, and ground in water into a very fine powder, which by conſtant waſhing is ſeparated from the coarſer parts; the ſame is afterwards dried in little warm chambers, then put into barrels, and thus it is exported into ſeveral countries: If one of the melting pots happens to break, or to be very much burnt ſo as that it muſt be taken out, they always find on the bottom thereof two cakes of different ſtuff, not mix'd with each other; the undermoſt is a ſort of *Æs Caldarium* or *Glocken Speiſe*, and the uppermoſt a marcaſite: The graſs and fruits growing thereabouts, where ſuch a workhouſe ſtands, are commonly poiſon'd by the arſenical ſmoke, ſo that neither cattle nor men can feed upon them with ſafety.

Plate XI. Fig. 2, 3, the furnace where the *Cobalt* is roaſted, and the arſenic ſeparated; *a* the furnace to roaſt the powder'd *Cobalt*; *b* the chimney, that receives the arſenical ſmoke; *ccc* the channel of ſtones to collect the arſenic.

Fig. 4. The furnace for melting the *Cobalt* into a glaſs; *aaa* *a* the hole where the melting pots ſtand; the large holes, where they put in the pots, are ſhut up with bricks, and a little hole as *bbbb* is left open, where they take out the glaſs with the iron ſpoon.

Fig. 5. repreſents two grinding ſtones to grind in water.

Spots *obſerv'd in the* Sun; *by Captain* Stannyan. Phil. Tranſ. N° 294. p. 1756.

ON *Saturday May* the 15th, *Anno* 1704, as captain *Stannyan* was obſerving the ſetting of the ſun, in order to examine his clocks, there appear'd two ſuns; the mock-ſun ſeem'd to be above the real one, which was then only five degrees above the horizon; whereupon, he took a good ſeven foot teleſcope, with a ſmall aperture, and ſoon diſcover'd a ſolar ſpot near the ſun's center, which he deſign'd to obſerve more exactly the following day, but it prov'd cloudy; on *Sunday* there was no ſunſhine; on *Monday* the 17th at ſix o'clock in the morning he took the ſame teleſcope, arm'd with a clouded eye-glaſs, and he immediately perceiv'd that the ſpot was advanced conſiderably towards the ſun's weſtern limb; it ſeem'd to be of a ſtrong conſiſtence, very compact, reſembling a face, and it was diſtant, by

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noon, from the anterior limb of the ſun's diſk 61″ of time, as repreſented in Plate XI. Fig. 6: On *Tueſday* the 18th at noon he found the ſpot diſtant from the preceeding limb 46″ of time; on *Wedneſday* the 19th at noon he obſerv'd, that the ſpot was mov'd within 33″ of time of his weſtern limb: On *Thurſday* at noon it was arriv'd within 21″ of time of the preceeding limb; moving nearly in a ſtrait line, and interſecting the parallel of declination, paſſing thro' the ſun's center; on *Friday* the 21ſt there was no ſun-ſhine; on *Saturday* the 22d at ſeven o'clock in the morning he obſerv'd, that the ſpot was advanced very near the limb of the ſun's diſk; on *Sunday* the 23d at ſix in the evening he ſaw the ſpot, which by that time was got to the very edge of the ſun's diſk, reſembling a barley-corn, lean and ſlender, and of a duſkiſh colour; only wanting its ſhorteſt diameter of the ſun's limb, all which appearances are repreſented in the above figure; at eight o'clock he obſerv'd it again; alſo at 10 and at 12; at two he perceiv'd that it was got into the very circumference, and was hardly viſible, had he not had an eye upon it all the day long; at four he examin'd the ſun's body with a very good 18 foot teleſcope, but he could not perceive the leaſt glimpſe of it; ſo that about three in the afternoon it totally diſappear'd; on *Thurſday June* the 23d, about ſix in the evening he obſerv'd with his 18 foot glaſs four ſpots in the ſun's diſk, as in Fig. 7. which were inviron'd with a miſt, thicker on the right hand than on the left, ſituated in the upper left hand quadrant, and diſtant from his neareſt limb about the 12th part of the ſun's diameter; from the cloud about them proceeded both ways five long curve rays, of a yellower colour than the ſun's body; he could never ſee theſe ſpots any more, tho' he had watch'd them for ſeveral days together; on *Monday June* the 7th, at three o'clock in the afternoon, he diſcover'd the ſame ſpot, as he thought, that he ſaw go off the ſun's diſk on *May* the 23d, re-entering the ſun's diſk juſt at the time and place he expected it; at four o'clock, the ſun being extremely clear, he mounted his 18 foot teleſcope, thro' which the ſpot appear'd diſtinct, but ſlender like a ſpider, with an elliptical ſpeckly miſt about it, and five or ſix light colour'd ſtreaks; it appear'd to him to be divided as it were near the top, as in Fig. 8; *Tueſday June* the 8th, at ſix in the morning the ſpot was very viſible, and he ſaw it trace again its former path, coming on exactly where he expected; it kept its ſhape; but thoſe lemon-colour'd ſtreaks diſappear'd, tho' itſelf and the miſt about it became viſibly bolder and broader, as it re-enter'd the ſun's diſk; on *Wed-*

neſday the 9th at five o'clock in the evening he obſerv'd the ſpot with the 18 foot teleſcope; but he could not perceive that it had alter'd its ſhape; but it advanced gradually over the ſun's diſk, as it had done formerly; on *Thurſday* the 10th, the ſun ſhining very bright at noon, he had an opportunity of being aſſur'd it was the ſame ſpot; he plainly ſaw it move over its former path, and it was then diſtant from its neareſt limb 29 ſeconds of time; at five in the evening he obſerv'd, with his 18 foot teleſcope, that its ſhape was alter'd, appearing bigger and blacker than ever, as in Fig. 9; *Friday June* the 11th was a bad day for obſervations, yet he had a ſight of it with the 18 foot teleſcope, and it ſtill continu'd black and bold as before; on *Saturday* the 12th, at ſeven o'clock in the morning, the ſun's body being very clear, he ſaw the ſpot thro' the 18 foot teleſcope, and it retain'd its former ſhape; on *Sunday* the 13th, the ſpot was arriv'd by noon, at the ſame point of the ſun's diſk, he found it in on *Monday* the 24th of *May* at noon; which made him inclinable to believe it was the very ſame ſpot; on *Monday* the 14th of *June*, he meaſur'd the diſtance of the ſpot from the next limb of the ſun's diſk, which he found to be 45 ſeconds of time from the anterior edge of the ſun's body; and on *Tueſday May* the 18th, it was obſerv'd to be in the very ſame place of its path, within a ſingle ſecond of time; at four o'clock he view'd it with his 18 foot teleſcope, and perceiv'd that it had alter'd its ſhape, as in Fig. 10; and it was diſtant from the preceeding limb 612 ſuch parts, as the ſun's ſemidiameter is 900; on *Tueſday June* the 15th at noon, the ſpot was 32 ſeconds of time diſtant from the leading limb of the ſun's diſk, and cover'd that very place, where the ſame ſpot had been obſerv'd on *Wedneſday* the 19th of *May*; on *Wedneſday* and *Thurſday* there was no ſun-ſhine; on *Friday June* the 18th at noon he obſerv'd the ſpot become very ſlender, but yet it was black and bold to appearance; the miſtineſs about it on the right hand was perceivable, and that on the left was become ſlender, in proportion to the ſpot itſelf, and he found it diſtant five ſeconds of time; on *Saturday* the 19th at five in the morning, it being clear weather, he ſaw the ſpot diſtinctly with his ſeven foot teleſcope; at nine o'clock he mounted his 18 foot teleſcope, obſerving once in each half hour all that morning; at 12 he perceiv'd, that all the cloud or miſty matter, that us'd to ſurround the ſpot, was inviſible; and the ſpot itſelf was reduced to little or no breadth, in compariſon to what it had been towards the ſun's center; and it

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was ſo cloſe to the limb of the diſk, that he could only perceive a ſmall ſtreak of light between it and the limb of the ſun's body; at two o'clock he could juſt perceive it, but it was become exceeding ſlender: The firſt revolution, he ſaw the ſpot half in the circumference of the ſun's limb at two o'clock on *Sunday* the 23d of *May*; and with the 18 foot teleſcope he juſt perceiv'd its ſecond revolution, at half an hour after two o'clock on *Saturday* the 19th of *June*; on *Sunday June* the 27th, about ſix o'clock in the evening, he obſerv'd ſeveral ſpots in the ſun's diſk, but he had not the conveniency of uſing his longeſt teleſcope; on *Tueſday June* the 29th, about ſeven in the morning he reckon'd 16 remarkable ſpots in the ſun's body, and near his center they appear'd thro' the 18 foot teleſcope, as in Fig. 11; then he took his ſeven foot teleſcope and frame, and he obſerv'd that the foremoſt cluſter of ſix ſpots, that appear'd on the paper like one ſpot, was diſtant from the ſun's anterior limb 81 ſeconds of time, and the laſt cluſter 87, as in the ſaid Fig. this day the foremoſt ſpot was diſtant from the following limb, according to the path of the ſpot, juſt 55 ſeconds of time; the ſun's diameter was always 136 ſeconds in the tranſit, and the ſpot was 126; ſo that the path of the ſpot was 10 ſeconds ſhorter than the ſun's diameter; on *Wedneſday June* the 30th, at eight o'clock in the morning, obſerving the ſolar ſpots with his 18 foot teleſcope, he very plainly perceiv'd, that they had mightily increas'd in number, and had ſtrangely chang'd their places; the cluſter of ſeven ſpots ſeem'd to him to move gradually, as the ſingle ſolar ſpot did in *May*, but the cluſter of four ſpots went too faſt forwards; the 12 ſpots without a miſt about them ſtraggled all manner of ways; and the nine ſpots, and the five black little ones went backwards, and at the ſame time unbent themſelves as it were into a ſtraight line, as in Fig. 12; the captain was apt to believe that this cluſter went backwards, as the other went forwards too faſt, or faſter than ordinary; for in 24 hours, the foremoſt cluſter advanced 21 ſeconds of time, which is more by ſix ſeconds than ever the ſingle ſpot mov'd in that time, even when neareſt the ſun's center; and the diſtance in time between the firſt and the laſt cluſter this day was greater by three ſeconds than the day before; the foremoſt cluſter of four ſpots was diſtant from the advancing limb of the ſun 60 ſeconds of time; at half an hour after four the advancing cluſter paſs'd the interſection in 55 ſeconds of time, after that the ſun's foremoſt limb had paſs'd conformably to the path of the ſpot; and the

laſt ſpot paſſed in 63 ſeconds of time, the laſt limb paſſing the interſection, according to the path of the ſpot, in 126 ſeconds of time, and the ſun's largeſt diameter paſſing in 136 ſeconds; by this time the ſpots appear'd ſtrangely black, and very oddly ſhap'd, as in the upper part of the circle in the ſaid Fig. On *Thurſday July* the 1ſt, at eight o'clock in the morning, he obſerv'd the ſolar ſpots with his 18 foot teleſcope, the weather being good, and he ſaw that they were ranged in reſpect of each other, as is repreſented in Fig. 13; the leading and largeſt ſpot being diſtant from the anterior limb 44 ſeconds of time; the laſt cluſter, lying a little awry, paſs'd in 53 ſeconds; after the anterior limb had done ſo, the following limb alſo paſs'd the interſection, according to the path of the ſpot, in 125 ſeconds of time; on *Friday* and *Saturday* there was no ſun-ſhine; on *Sunday July* the 4th, in the morning at eight o'clock, the leading ſpot was diſtant from the advancing limb 10 ſeconds of time, the ſpots and cluſters retaining nearly the ſame ſhape, but beginning to contract themſelves; the foremoſt he thought, look'd ſtrong enough to perform another revolution, and it paſs'd in 127 ſeconds; on *Monday* the 5th at ſeven o'clock, he found that the ſpots had quite alter'd their ſhape, appearing dull and ſlender, as in the lower part of the ſcheme, and diſtant about four ſeconds, being all included in a cloud; on *Tueſday* the ſixth, at 10 o'clock viewing the ſun's diſk with his 18 foot teleſcope, he found it clear of all ſpots; on the 17th day of *July*, about four o'clock in the afternoon, he obſerv'd ſome ſpots in the ſun's body, reſembling thoſe he ſaw on *Thurſday* the 3d of *June*; only with this difference, that theſe appear'd to him, as if they had been heated red hot; they ſeem'd to be in the ſame part of the ſun's diſk; that day he obſerv'd them above an hour together, but he could never afterwards, nor diſcover, whether they were coming on or going off his viſible diſk; captain *Stannyan* continu'd to obſerve the ſun, as often as was poſſible, with his 18 foot teleſcope, till the end of the month, but without farther ſucceſs.

Concerning Foſſils *in* Switzerland; *by M.* Leewenhoeck. Phil. Tranſ. N° 294. p. 1774.

M. *Leewenhoeck* is of opinion that mountain cryſtal is not produced from ice, nor that it grows in the mountains, where it has its increaſe, as ſeveral ſuppoſe; but, that where it is fix'd in the mountains, it is coagulated by the air, which with

with a little moiſture is ſhut up therein; and that the parts of cryſtal being ſeparated, are again reſolv'd into long particles, of which a great many are hexangular: M. *Valkenier* gave M. *Leewenhoeck* four ſmall ſnail-ſhells which were gather'd in the mountains of *Switzerland*, where thro' length of time they were changed into metal, for they were very heavy; M. *Leewenhoeck* for his farther ſatisfaction, took one of the ſnail-ſhells, that he judged to be metal, and beat it to pieces with a little hammer; but, finding that it broke very eaſily, he ſeparated the fore-part with his fingers; a ſmall particle of which, repreſented by A B C D E Plate XI. Fig. 14. he placed before his microſcope; B C D was what was join'd to the fore-part of the ſnail-ſhell, wherein he obſerv'd ſix prominent particles, and five others at A E, which were fitted or inſinuated into the ſix particles; and how often ſoever he broke the ſaid ſhell into pieces, he ſtill obſerv'd in the fore-part ſix, and in the hinder part five particles in the ſame order and diſpoſition; ſo that he ſuppos'd, it muſt have been a limb, or part of the incloſ'd ſnail; and conſequently, that it had been once a live animal; having placed the broken part of one of theſe little pieces of ſnail-ſhell, before the microſcope, he obſerv'd that the internal matter was compos'd of very ſmall ſhining particles, which a perſon would take to be broken pieces of metal; foraſmuch, as he had ſeen ſuch like ſeeming particles of metal, which was really nothing but brimſtone, he took ſome of the ſmall pieces of the ſhell, and putting them into a glaſs, and then upon the fire; he obſerv'd, that in proportion to the ſmallneſs of the parts, a great deal of water and ſulphur was extracted from them, without diſcovering the leaſt ſign of metal in the remaining black matter; moreover, he examin'd that little piece of matter, which he judg'd to have been the live animal within the ſhell; by its uncommon weight it ſeem'd to have been alſo turn'd into metal, and the more ſo, when he had broken it to pieces; for then, the great number of exceeding ſmall ſhining particles appear'd to be wholly metalline; the abovesaid matter was very hard, inſomuch that when he ſtruck it againſt a ſteel, it yielded ſparks of fire; he broke off a piece thereof, and placing the remainder before a microſcope, as ſhewn in F G H I Fig. 15. the more one view'd the break as repreſented by G H, the more one would be perſuaded, that the manifold ſmall ſhining particles were certainly metalline; but, when he brought it to the fire, and endeavour'd as much as he could

could to keep the ſmoke together, it appear'd plainly to him to be nothing but ſulphur; which was manifeſt, not only from the ſmell thereof, but the extract was of a yellow colour, juſt as ſulphur appears to the naked eye: Now, that Fig. 14. A B C D E is a part of a real ſnail is clear to him; but how, and after what manner the ſulphur got into the ſhell we can only gueſs; M. *Leewenhoeck*'s opinion of the matter is this; the ſnails and other things, that are found upon the mountains of *Switzerland*, and which are ſuppos'd to be changed into metals, have lain and do ſtill lie, where a great quantity of ſulphur is ſhut up in the bowels of the earth; and that ſulphur, being render'd fluid by a ſubterraneous heat, mounts upwards in exceeding fine particles like fire, and ſo inſinuates itſelf not only into the inmoſt parts of the ſnail-ſhell, where, according to all appearance, the ſnail itſelf is almoſt conſum'd, but alſo into the pores of the ſhell, and is there fix'd and coagulated, ſo that the whole ſnail is converted into a ſulphureous ſubſtance: This may ſeem ſtrange to ſome; but ſuch as are converſant in ſulphur, and know into what an unſpeakable great number of ſmall parts it can be divided by fire, may eaſily conceive, into what a number of bodies, ſulphur, being put into a fluid motion, can in the courſe of ſome ages, inſinuate itſelf; for as M. *Leewenhoeck* has been informed, theſe ſnails and other teſtaceous animals, which are found in the high mountains of *Switzerland*, have lain there ever ſince the deluge; and ſo, many of them by length of time become metallic bodies, or rather as M. *Leewenhoeck* ſuppoſes, moſtly ſulphureous; now, in order to ſhew the exceeding ſmall particles into which ſulphur is divided, by fire, he prepared a little glaſs globe, repreſented by A B C D, Fig. 16. and therein at B he placed a ſmall particle of ſulphur about the bigneſs of a ſingle grain of ſand; and when the glaſs, and the included air was ſo temperate as the air we commonly breathe in, he ſealed hermetically that part of the glaſs which was open at E; and then blowing the flame of a candle upon the other part of the glaſs, where the ſulphur lay, till it evaporated into ſmoak; which for a ſmall ſpace of time was carried about the glaſs in a circular motion, and after that the ſulphureous ſmoke had ſubſided, and ſettled itſelf on the glaſs, he examined it with a microſcope, and obſerved ſo many exceeding fine particles on the ſides of the glaſs, that no perſon could believe, that ſuch a ſmall grain of ſulphur could poſſibly be divided into ſo many parts; inſomuch, that the ſmalleſt globules of this divided ſulphur could hardly be obſerved with one of his beſt

beſt glaſſes; and the largeſt globules lay round about the ſulphureous matter, that was not quite diſſolved: He let the glaſs-globe lie ſtill about half an hour, and then viewing it anew, he was ſurprized to find, that ſome of the ſmall globules of ſulphur that lay a little remote from the reſt, had formed themſelves into a right-line, and that four or five were placed lengthwiſe; and that ſome globules were ſo extended in length, that they touched each other; but ſome hours after, they were all united, and compoſed one ſmall body juſt like ſaltpetre, when joined to water it begins to coagulate; theſe inclinations or coagulations were the more ſurprizing, becauſe ſome of them were twice, others thrice as long, as ſome others that lay thereabouts; and juſt by theſe coagulated long particles there lay other ſulphureous ones, but none very ſmall: It is true, that in the fluid ſubſtances we daily ſee, homogeneous particles do, thro' a ſecret inclination, coagulate together; but how the particles of ſulphur, that are glewed down as it were, to the glaſs, ſhould aſſemble and unite into one body is very ſurprizing.

M. *Leewenhoeck* had a ſnail-ſhell, as repreſented by K L M N O. Fig. 17. which was very heavy in proportion to its bigneſs, and ſeemed to him not to be quite whole, but that ſome part was broken off at L M; upon breaking it to pieces, it ſeemed to be full (excepting the ſlendereſt part of the tail) of a pale yellowiſh ſubſtance, that was viſible enough to the naked eye: M. *Leewenhoeck* to ſatisfy himſelf, about the ſaid apparent metalline particles, put about a fourth part of the laſt-mentioned ſnail-ſhell into a glaſs, and brought it to ſuch a ſtrong fire, that the glaſs was juſt ready to melt; in this operation, he ſeparated a great deal of ſulphur from it; and when he took the remaining matter out of the glaſs, he obſerved that all the ſulphur was not quite extracted; for he diſcovered ſeveral ſulphureous particles lying in the remaining matter, which one would take for a black burnt earth; and they were divided from each other in oblong particles, each having diſtinct figures, according to the places they were to poſſeſs; he ſealed up hermetically the glaſs, wherein the extracted ſulphur was coagulated, to the end that no moiſture or vapours might either get in, or eſcape out of it; and then viewing thoſe ſulphureous particles, that had lain fartheſt from the fire, he ſaw, (tho' nothing thereof was perceptible to the naked eye) that the glaſs was covered with globules, juſt as if one had ſpread a table all over with ſand; and when he viewed the ſame a little while after, he ſaw that the ſmall particles were coagulated together into irregular figures; and as he imagined

before

before, that the ſmall ſulphureous particles were faſtened to the glaſs, now he ſaw an oleaginous, and watry ſubſtance, which might be called the ſpirit of ſulphur, drawn off together with the ſulphur; and that ſeveral places in the glaſs had no globules, and nothing to be ſeen but this oleaginous matter: He had alſo a third ſnail-ſhell, whoſe outermoſt part or ſhell, was as ſmooth as if it had been poliſhed; and when he view'd it thro' a microſcope, he obſerved that it was adorn'd with ſurpriſing figures; from which he concluded, that the luſtre or ſmoothneſs of the ſhell was occaſioned by a long and frequent attrition thereof againſt other hard bodies; as is to be ſeen in ſtones that are found on the ſea-ſhore; which, by the frequent motion of the waves of ſand about them, become very ſmooth and poliſhed; and it was by ſuch motions, that the fine figures in the ſhells are quite worn out; this ſhell deſcribed by Fig. 18. PQR, he could break very eaſily with his fingers, and diſcover with his naked eye, that it was for the moſt part compoſed of the above-mentioned ſhining matter, as alſo full of ſulphur: He had alſo another ſnail-ſhell, repreſented by TVW. Fig. 19. which was alſo very ſmooth; and upon breaking that ſhell to pieces, what ſeemed to be ſo ſmooth to the naked eye, did now appear with as many ſcratches, as if it had been rubb'd with ſharp ſand; and this was likewiſe adorn'd with figures, that were not diſcernable by the naked eye; a ſmall part of which is repreſented by ABCDEFGH. Fig. 20. which was raiſed a little above the other part of the ſhell, and ſome part was lower as BCD.

The above-mentioned M. *Valkenier* gave him a little body, whoſe ſhape is repreſented by XYZ. Fig. 21. which is alſo found in the mountains of *Switzerland*; and it ſeeming to the naked eye to conſiſt of three joints, he endeavoured to ſeparate them from each other, in order to diſcover, if poſſible, its internal figure; and tho' he attempted to divide it in the jointed parts with a ſharp ſteel, yet he could not compaſs it, but broke it into irregular pieces, all which were ſo ſmooth and ſhining within, that the like never occured to him in any common-ſtone; and moreover, it was more than ordinary hard; the beſt judgment M. *Leewenhoeck* could form of it was, that it conſiſted of flat parts; he laid the biggeſt piece thereof upon wood-coal, and brought it gradually into a ſtrong glowing heat; in doing of which, at firſt ſome ſplinters flew away; and he could not perceive, that there was any ſulphur in it; whereupon, he dropped it into a ſmall copper-veſſel, wherein was a very little water, to ſee, whether that would ſeparate the parts, in order the better to

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diſcover the homogeneous particles; but, inſtead of doing ſo, it divided into a vaſt number of unſpeakably ſmall white particles, which may be call'd a chalky ſubſtance; as ſoon as this chalky matter was ſeparated, he obſerv'd a film or ſcum upon the water, which he ſuppos'd to be the coagulated ſalts thereof; he took a little of the ſaid water from under the ſcum, and pour'd it upon a clean glaſs, and viewing it preſently after, he diſcover'd to his great ſurpriſe, ſuch a vaſt number of clear and tranſparent ſalt particles (ſeveral of which were ſo fine and ſlender, that they ſeem'd to have but one circumference) and of ſuch various and different figures, that there was no tracing them; and they were ſo very ſmall, that ſeveral thouſands of them together could not equal the magnitude of a ſingle grain of ſand; and foraſmuch, as a great many of them were long, he imagin'd that that figure might be peculiar to them; and that all the reſt had only aſſum'd a borrow'd form, which might be determin'd, by the different manner of their uniting or coagulating in ſeveral places; he let the water ſtand a few days upon the chalky ſubſtance, till it was all evaporated, and then he diſcover'd a great number of very ſmall ſhining particles, lying at the bottom of the above copper-veſſel; all which he took out as clear as he could, and placed them on three ſeveral clean glaſſes, and then viewing them with a microſcope, his ſurpriſe was ſtill greater; for he obſerv'd, not only different figures, but that no two of them were alike; but all of them were as clear and tranſparent as cryſtal; yea, ſome of them had as fine and regular points as a wrought diamond, tho' above a thouſand times ſmaller than a coarſe grain of ſand; amongſt others, there appear'd to him ſuch a triple-jointed body, as is repreſented by X Y Z Fig. 21. which he alſo endeavour'd to ſeparate by its joints, but in vain; he alſo laid this upon wood-coals to make it glowing hot, as he had done the other, but a good part thereof flew away, when it was but juſt warm; and as it began to be hotter, it flew ſo about, that had he proceeded farther, he could have ſav'd none of it; whereupon, he took a glaſs-tube above a hand's breadth in length, and hermetically ſeal'd at one extremity, into which he put what remain'd of the abovementioned figure; and then heating that extremity of the tube, the ſaid matter burſt with great violence into ſuch ſmall particles, that ſeveral of them ſeem'd as fine as meal or flour; and if he had not ſtopp'd the open extremity of the tube with his finger, moſt of this diſſolv'd matter would have forced its way out; afterwards, he put the ſaid tube into a glowing heat,

when he obſerv'd, that a great deal of thin watry vapours were extracted from the reſt of the aforeſaid ſubſtance; and upon viewing the ſmall particles that were on the inſide of the glaſs, he ſaw a great many very thin ſcales, ſome of which had right angles; and all of them ſeem'd to be compos'd of ſuch ſmall particles, as fine ſand appears to be to the naked eye; he took the aforeſaid matter out of the glaſs-tube, and placed it upon a wood-coal, in order to put it into a greater heat; but, as ſoon as he had put it on the fire, the ſmall particles flew away ſo faſt, that he was obliged to put it into the tube again; and after having made it red hot, he pour'd it out of the tube into the water; but the heat was not ſo great as to make it turn into a chalky ſubſtance, excepting a little piece, no bigger than a pin's head, which he heated again without flying or breaking, and dropping it into the water, it diſſolv'd into a chalky ſubſtance; he had ſeveral ſuch like particles, but much ſmaller, conſiſting of five joints or ribs, which are alſo found upon the mountains of *Switzerland*; he ſlit this particle, repreſented by I K Fig. 22. thro' the joints, but he could not do it ſo nicely, but that a ſmall piece of another joint ſtuck to the largeſt; whereby, he could not ſo perfectly diſcover the roſe like figure, as repreſented by I; he alſo laid theſe ſlit particles upon wood-coals, intending to heat them leiſurely; but they flew about ſo, that had he proceeded, there would have been none left upon the coals; wherefore, he alſo put them into a glaſs-tube, as before, but without any other ſucceſs, tho' he held the tube and the aforeſaid matter in it; firſt in the flame of a candle, that it might be leiſurely heated; and by this means it was diſſolv'd in ſuch a manner, that it ſeem'd to be nothing but a powder; and in this operation there was ſome moiſture exhal'd; from this ſurpriſing burſting, and that into ſuch ſmall pieces, he concluded, that a great many watry particles were ſhut up in this matter; and that theſe particles were ſo ſtrongly united, and were, moreover, of ſo tenacious a ſubſtance, as did not admit of the leaſt evaporation of moiſture; and that theſe watry particles, being rarified by heat, requir'd a larger ſpace, and ſo occaſion'd the burſting of the ſaid matter; he ſet the ſaid tube with the powder in it over ſo violent a heat that it was ready to melt; and immediately after, he pour'd the powder into water, but it did not become a chalky ſubſtance; and afterwards, decanting the water into a clean glaſs-tube, he obſerv'd, that it was impregnated with ſalt particles; in this operation he ſaw upon the ſides of the glaſs a great number of exceeding

ceeding thin particles like IK Fig. 22. and ſuch as were the thinneſt now appear'd juſt as the ſmall pits on the outſide of a thimble do to the naked eye.

Fig. 23. NO repreſents one of the ſmall ſplinters that burſt in the fire, as it appear'd before a microſcope; this ſplinter was ſo narrow, that it had but three rows of little pits or holes, which were all three no broader than a hair of the head; and the holes in ſome other ſplinters were ſtill ſmaller: From theſe diſcoveries, M. *Leewenhoeck* was led to conſider, whether there had not been ſome matter ſhut up in each of theſe holes, which being rarified by the heat, poſſeſs'd a larger ſpace; but all being cloſe ſhut up, and having no paſſage thro' the pores, occaſion'd thoſe bodies, repreſented by IK Fig. 22. to burſt into ſo many thouſand pieces.

M. *Valkenier* gave M. *Leewenhoeck* two little dice, as repreſented by LM Fig. 24. adding, that ſome people ſaid they were ſtone, others bone; and that they were found deep under ground in *Switzerland*, and in great numbers, in a place where there had been formerly a *Roman* camp; and that the *Swiſs* were of opinion, that the *Roman* ſoldiers, whilſt they were encamped there, made uſe of them in play; M. *Leewenhoeck* ſtruck ſeveral blows with a hammer on one of theſe dice, which indeed made holes in it, but without breaking it; whereas, had it been ſtone, it could not have withſtood ſo many blows; at laſt, cutting off ſome ſmall bits, and making them glowing hot in the fire, he obſerv'd, that it was black, as bone is, when it has not lain long therein, and white when it has lain longer; in his laſt viewing of it, he was ſtill the more confirm'd that it was bone, for he could then diſcover the pores of a bone; yet, he ſuppoſes that it could not be an ox-bone, becauſe the pores were ſmaller.

Experiments *about the Motion of* Pendulums in Vacuo; *by Mr.* Derham. Phil. Tranſ. N° 294. p. 1785.

MR. *Hawksbee* made an experiment to diſcover the difference between the vibrations of *Pendulums in Vacuo*, and in air; the movements he tried with, were an eight day clock vibrating ſeconds, and another half ſecond movement of Mr. *Derham*'s; the *Pendulum* of this latter vibrated $\frac{3}{10}$ of an inch on each ſide farther *in Vacuo*, than it did in the free air; and went ſeven ſeconds ſlower in 20 minutes, than the other; but in the open air it went in 20 minutes, only three ſeconds and a half ſlower than the other *Pendulum*.

Mr. *Derham* himſelf tried this experiment with the following inſtruments; as an air-pump of Mr. *Hawksbee*'s; the aforeſaid ſmall movement, with a *Pendulum* of about 10 inches, vibrating half ſeconds, and driven by the power of a ſpring; this inſtrument was commodious, not only for being eaſily fitted with a receiver, but alſo for vibrating half-ſeconds very nicely; and alſo becauſe its vibrations were equal; the laſt inſtrument was a very well regulated month-piece, vibrating ſeconds, with tolerable exactneſs: The reſult of ſeveral repeated experiments was, that the vibrations *in Vacuo*, as before were always larger, than in the unexhauſted receiver; at firſt, after Mr. *Derham*'s little movement was newly clean'd, the vibrations were above $\frac{1}{10}$ of an inch larger than in the free air; but afterwards (he ſuppoſes from ſome of the foul'd oil of the pump ſparkled on the wheels, in letting in the air, whereby the force of the ſpring on the pallets was weaken'd) as the vibrations in the unexhauſted receiver were a little contracted, ſo in the exhauſted receiver they were more contracted, and only about 0,25 of an inch larger than in the free air: The alteration in time, which this difference of the vibrations produced, was conſtant, only about two ſeconds in an hour ſlower in the exhauſted, than in the unexhauſted receiver; for, if in four, five, or more hours going, the two *Pendulums* did not vary $\frac{1}{4}$ of a ſecond in the open air, or when the unexhauſted receiver was put over the little movement; yet when exhauſted, the half-ſecond movement would in ſeveral hours going, loſe in every experiment at the rate of two ſeconds in every hour; in order to obſerve what alterations would ariſe from varying the vibrations; he therefore, by opening and ſhutting the pallets, caus'd the vibrations in ſome experiments to be as large as the receiver would bear; in others, to be as ſhort as poſſible, always adjuſting the *Pendulum* to vibrate half-ſeconds nicely in the air; but ſtill the ſucceſs was much the ſame, or the difference was ſcarcely perceptible; only Mr. *Derham* imagin'd, that when the *Pendulum* vibrated but a little way from the perpendicular, the vibrations *in Vacuo* were not ſo much enlarged, as when it vibrated in a larger arch: In all theſe experiments, repeated divers times with the ſame ſucceſs, he had reaſon to think that the vibrations were enlarged *in Vacuo* by the vaſt rarefaction of the *medium*, only, that perhaps the different ſtate of the air might alter the force of the ſpring, which drove the movement; to be ſatisfied about this, he put a well adjuſted pocket watch (with Dr. *Hook*'s *Regulator*; i. e. the common ſmall ſpiral ſpring to the ballance) *in Vacuo*; and after ſeveral trials, at the ſame pitch of the ſpring, he

he did not find the leaſt alteration in the watch's going in ſeveral hours; neither the ſprings, nor any other part of the watch ſeeming to be in the leaſt affected by the *Vacuum*, the ballance circumvolving, or keeping the ſame turns, as in the open air; but to be ſtill more certain, he tried what the ſucceſs would be by putting the half ſecond *Pendulum* into the receiver again, and only exhauſting a part of the air; and accordingly, he left no more air than what kept the included mercurial gauge at about ſix inches high; the event of which was, that the vibrations were then not above $\frac{1}{10}$ of an inch larger on each ſide, than in the receiver unexhauſted; and the time loſt was, but about $\frac{1}{4}$ a ſecond in an hour, or $\frac{3}{4}$ at moſt; and ſo, according as the mercurial gauge was more or leſs high, he always found the vibrations larger or ſmaller, they gradually decreaſing, according to the quantity of air re-admitted.

From theſe experiments Mr. *Derham* makes the following remarks. 1. That what Mr. *Boyle* long ſince obſerved (from a cock'd piſtol going down as fiercely in his *Vacuum*, as in the air) may be hereby farther confirm'd; *viz.* that the air is not the cauſe of the motion of reſtitution in ſolid bodies, as ſprings; for if it was, it would certainly have been diſcover'd in ſo tender an inſtrument, as a well adjuſted pocket watch, lying under the conſtant influence of two ſprings. 2. As *in Vacuo* (where the preſſure of the atmoſphere is taken off) heavy bodies deſcend quicker than they do in the open air; ſo it may be obſerv'd, that *Pendulums* move ſwifter in the exhauſted, than in the unexhauſted receiver; that heavy bodies deſcend quicker *in Vacuo*, is evident from the ſwift deſcent of the leſs heavy bodies; as cork, the down of ſow-thiſtles, the lighteſt feathers, *&c.* which do all deſcend precipitantly, like a ſtone, in a tall exhauſted receiver; and that the *Pendulum*, in the above experiment, mov'd faſter *in Vacuo*, is manifeſt from its vibrating but two ſeconds in an hour ſlower, when the vibrations were $\frac{1}{3}$ of an inch on each ſide, enlarged by the higheſt rarefaction of the air; whereas Mr. *Derham* found by experiment, that nearly the ſame increaſe of the vibrations, makes the *Pendulum* in the open air go ſix or more ſeconds ſlower in an hour; he ſays, nearly the ſame increaſe; becauſe it is ſcarcely poſſible to manage the pallets ſo nicely, as to make the ſame vibrations as were *in Vacuo*. 3. Mr. *Derham* queries, whether the variations of *Pendulums*, obſerved under the *Equinoctial*, and between the *Tropics*, do not ariſe as much, or more from the rarity of the *Medium*, and the increaſe of the vibrations conſequent thereupon? It is ſcarcely to be doubted, he thinks,

thinks, that the air is much thinner, and finer near the *Line*, than it is without the *Tropics*; and it is evident from the barometer, that, on the tops of high mountains, the atmosphere gravitates less than nearer the center; and therefore (tho' he approves of the notion of the decrease of gravity from the increase of the distance from the center of the earth, yet) he is apt to think, that this is not the only reason of the phænomenon; therefore, he wishes that Captain *Halley*, when he observed, that his clocks went slower at St. *Helena*, than in *England*, had at the same time observed, whether the vibrations were not enlarged: It would therefore, be worth the while for such as have an opportunity, to take notice, whether their *Pendulums* between the *Tropics* do not make larger arches, than in higher latitudes? As also, in what latitude they begin to alter? Whether the vibrations be greater near the *Line*, than in any other part between the *Tropics*? Or, whether the greatest increase be not always in those places, where the sun passes their *Zenith*? If the vibrations be found larger under the *Line*, or in any other part of the *Torrid Zone*; then it may be observed, how much larger they are, and in what proportion they increase or decrease, by approaching nearer to, or receeding from the place of their greatest increase? Also, it may be worth observing, whether *Pendulums* do not vary on the tops of high places, or in different states of the atmosphere, according as the mercury is high or low in the barometer? But then in this, and indeed, in the former cases, it is necessary, or at least very expedient, that the movement be so exactly well made, that the power, whether weight or spring, do at all times exert the very same force upon the pads or pallets, which is very rarely met with; for, most clocks are apt to vibrate sometimes larger, sometimes smaller arches in 24 hours, according as the weight or spring, does more or less exert its force on the work.

Animalcula *on the* Roots *of* Duck-weed; *by M.* Leewenhoeck. Phil. Transf. N° 295. p. 1784.

IN the month of *July* M. *Leewenhoeck* caused several of these weeds, as they were carried by the stream thro' *Delft*, to be taken out of the water in an earthen pot; and taking several times a full view of the *Animalcula* that were fastened to the small roots of that green stuff, they appeared as represented by ABCDEFG. Plate XI. Fig. 25. A B G shews the case or sheath, into which the *Animalculum* betakes itself, upon the least shaking or stirring of the duck-weed, and then thrusts itself out again as far as B C F G, when at the same time appear the two little wheels represented

preſented by CDEF; in obſerving the motion of which, a perſon would be apt to take them for two real revolving wheels; but as ſoon as he could place the *Animalculum* before his eyes, in ſuch a poſition as to view the little wheels, not partially, as here repreſented, but completely, and all at once, he was convinced of his miſtake in his former aſſertions; for now he plainly ſaw, that what appeared before to be two diſtinct little wheels was really one and the ſame circumvolution.

Fig. 26. HIKLM repreſents the ſaid wheels, larger than they appeared to the ſight, wherein the rotation proceeds from H to I, and ſo on from I to K, and from K to LM: M. *Leewenhoeck* was at laſt fully ſatisfied about this ſurpriſing and regular phænomenon; foraſmuch, as having thrown away thoſe weeds (to the roots of which the aforeſaid *Animalcula* adhered) and made his obſervations on ſeveral others, he found the ſame appearance every time, only with this difference, that the internal arches, repreſented by K and M, in the ſaid Fig. were not near ſo much indented. During theſe obſervations, one *Animalculum* appeared as repreſented by NOPQRST Fig. 27; N that part of it, by which it was faſtened to the weed; this *Animalculum* had its receptacle, or little houſe, repreſented by NOT, compoſed of round bubbles, which figure had not occurred to him before; when this *Animalculum* had thruſt that part of its body from O to P out of its caſe or ſhell, it extruded at the ſame time that ſurpriſing wheel-work that conſiſted of four round parts repreſented by PQRS in the ſaid Fig. three of which were to be ſeen very plain, but the fourth at T was almoſt hid from the ſight; this wheel-work moved from P to Q, and from R to S.

Fig. 28. ABCDEFGHIKLM repreſents that inſtrument, that in Fig. 27. is for the moſt delineated by PQRS; and is ſhewn with a larger circumference than it really appeared to the ſight, wherein was to be ſeen the ſaid teeth and wheel-work move from ABC to D, and from D to EFG, and in that manner perform its whole revolution; at the leaſt ſudden touch of the *Animalculum*, it preſently drew the wheel-work into its body, and then its whole body into its caſe or ſhell, ſo that nothing could be ſeen but a kind of horn, as NOT. Fig. 27. wherein it hid itſelf; but it quickly thruſt forth that part of its body repreſented by OPQRST, and then the rotation proceeded as before: Now if any ſhould be inclined to make this experiment, he muſt take care to chuſe out duck-weeds that have long roots; for, M. *Leewenhoeck* never obſerved any of theſe *Animalcula* in the

ſhort

ſhort roots of young weeds; nor indeed, in the large roots, when once they are covered with a rough matter, and tend to decay, as he has ſeen a great many in the beginning of *Auguſt*; and he has examined more than 25 roots, without meeting with any of theſe *Animalcula* thereon; as alſo, on the contrary, he has ſometimes found three of them upon one weed: Moreover, in one of his glaſſes, where M. *Leewenhoeck* had ſhut up a weed with its root, there was an *Animalculum* the third part of an inch long, and ſomething thicker than the ſmall root of the duck-weed; the body of which was for the moſt part tranſparent, only, there was a gut, or inteſtine, that ran thro' the whole length of the body, and was wrinkled, or ſhrivell'd up in ſeveral places; and as it came towards the head, it became rounder and thicker, which he ſuppoſed to be the maw or ſtomach; this gut was full of aliment throughout, which the *Animalculum* had gathered either from the roots, or the excreſcent particles round about; and foraſmuch, as the upper part of the head was provided with a long and pointed horny ſubſtance, like a ſturgeon; ſo likewiſe was the mouth inwards, and joined to the extremity of the belly; the ſaid gut being filled with aliment, was in a continual motion, which he calls a pinching or twitching, in order to the attenuation or protruſion of the chyle; and had not the guts been thus full of aliment, which hindered its tranſparency, he would have ſeen all the *Vertebræ* of the back-bone; the third day, after he had ſhut up the *Animalculum* in his glaſs, he ſaw a long and ſlender little worm, which he judged to be a thouſand times ſmaller than the aforeſaid *Animalculum*, which had inſinuated part of itſelf into the body of the *Animalculum*; and as far as it appeared to him, the worm laboured to get all its body in; and next morning he diſcovered, that it had in a manner got quite in; and at night he could ſee nothing of it but a little bit ſticking out; and then he could ſee, that in the place where the worm had inſinuated itſelf, the *Animalculum* was partly without any aliment, or motion; whereas, there ſtill continued ſome motion above and below that place; upon the fifth day after, he ſaw another worm attempting to get into the body of the *Animalculum*; upon which it made a great ſtir with its body, and ſo ſhook off its enemy; and preſently after he ſaw no motion in the guts; ſo that he concluded, that the death of the *Animalculum* was approaching; after which it abandoned the root of the duck-weed, and placed itſelf on the ſide of the glaſs, and in a little while after, he ſaw it lie dead at the bottom; from hence he firmly concluded, that the death of the *Animalculum* was occaſioned by the worm's piercing into its body,

body, whereby the guts were wounded in ſuch a manner, as to be deprived of all motion; among ſeveral ſorts of ſmall *Animalcula*, he obſerved three, whoſe bodies were about as thick as a hair of the head, and 10 times as long; theſe *Animalcula* were ſo tranſparent, that at firſt he took them for empty ſkins; for he could ſee nothing but an exceeding ſmall part thereof about the head, and the hinder part of the body, which was not tranſparent; and what he judged to be the bowels, was a ſmall part of it inclining to a yellowiſh colour; and they had on the fore-part of the head, as it were, two very crooked claws, and on the hinder-part of the body ſeveral tranſparent hairs; he obſerved theſe *Animalcula* ſeveral days together, and he always ſaw, that they moved their bodies very nimbly in a ſerpentine motion, and as it were in an inſtant of time, and ſo moved about from place to place; and as often as he viewed them, he could never find, that they ſat ſtill on the roots of the duck-weed, or on the ſides of the glaſs, but were continually roving about in the water; afterwards, when he viewed them again, he could not perceive the leaſt motion, either internal or external, in their bodies; but he obſerved, that ſometimes they ſubſided in the water, and then emerged again, but very leiſurely; which appeared ſurpriſing to him; becauſe, as he ſaid juſt now, he could not diſcover the leaſt motion in their bodies; tho' he does not doubt, but that their is ſome motion, be it never ſo ſmall, in a body, which in the ſpace of two or three pulſations, ſhall one time ſink to the bottom, and then emerge to the top; for it is impoſſible to ſet an inanimate body in water in ſuch a poſition, that it ſhall neither ſink quite down, nor emerge quite up to the ſurface; and tho' we could find a body (which M. *Leewenhoeck* thinks is not to be done) that ſhould be preciſely of the ſame weight with the water, yet it would not keep the place in the water which was firſt aſſigned it; for, according as the water, into which you put that body, would decreaſe or diminiſh in heat, that ſame water would proportionably take up more or leſs ſpace; and conſequently, the body that was placed, ſo as that it could neither entirely emerge nor ſubſide if the water, for inſtance, ſhould become warmer and ſo take up more room, would immediately ſink to the bottom: The only ſolution, therefore, that M. *Leewenhoeck* can give in this caſe, is that ſuch an *Animalculum* has ſome air in its body; and that by ſqueezing and contracting itſelf, it can emit ſome of the *Materia ſubtilis* mixed therewith, by which it naturally ſubſides; and *é contra*, by dilating its body again, an equal quantity of the ſame *Materia ſubtilis* is let in; and thus

the *Animalculum*, without ſtirring itſelf, will either riſe or ſink.

M. *Leewenhoeck* was the more eaſily induced to aſſert what he formerly did about the *Animalcula* faſtened to the roots of duck-weed, their having two diſtinct revolving wheels; becauſe he had diſcovered ſeveral *Animalcula* that protruded two wheels out of the fore-part of their bodies, as they ſwim, or go upon the ſides of the glaſs; one of which is repreſented by V W X, Fig. 29; in ſummer he found this ſort of *Animalcula* in great numbers in the gutter-water, which had ſtagnated for ſome days in the ſmall pits or cavities of the lead; theſe *Animalcula* are gradually leſs and leſs, ſo far that 50 ſmall ones are not ſo large as a full grown *Animalculum*, big with young; in the month of *October*, 1702, he cauſed the dirt of the gutters, when quite dry to be gathered together, and taking a ſmall quantity thereof, he put it into a paper upon his deſk; upon a little of which he had often poured boiled water, after it had ſtood till it was cold, to the end he might obviate any objection that ſhould be made, as if there were living creatures in that water; for theſe *Animalcula*, when the water runs off or drives away, contract their bodies into a globular or oval figure; after that the above-mentioned dry ſubſtance had lain near 21 months in the paper, he put the remainder of what he had by him into a glaſs-tube of an inch diameter, and poured thereon boiled rain-water, after it was almoſt cold; and immediately viewing the ſmalleſt parts, particularly, that which ſubſided leiſurely to the bottom, he obſerved a great many round particles, moſt of which were reddiſh, and they were certainly *Animalcula*; and ſome hours after, he diſcovered a few that had opened, or unfolded their bodies, ſwimming thro' the water, and a great many others that had not unfolded themſelves were ſunk to the bottom, ſome of which had little holes in their bodies; from whence he concluded, that the little creature called the mite had been in the paper, and prey'd upon the aforeſaid *Animalcula*; next day he ſaw three particular *Animalcula* ſwiming thro' the water, the ſmalleſt of which was a hundred times more minute than the aforeſaid ones; ſo that it is ſurpriſing, that theſe ſmall inſects can lie 21 months dry, and yet live; and as ſoon as they are put into water fall a ſwiming, or faſtening the hinder parts of their bodies to the glaſs, and then protrude their wheels, as repreſented in the Figure; in the month of *September* he put a great many of the laſt-mentioned *Animalcula*, into a wide glaſs-tube, which preſently placed themſelves on the ſides thereof; whereupon pouring off the water, he then obſerved that

ſeveral

ſeveral *Animalcula* to the number of 18 or 19, lay by each other in the ſpace of a coarſe grain of ſand; all which when there remained no more water, cloſed themſelves up in a globular figure; ſome of the bodies of theſe *Animalcula* were ſo ſtrongly dried up, that one could ſee the wrinkles in them, and they were of a reddiſh colour; a few others were ſo tranſparent, as if they had been little glaſs balls, that if you held them up between your eye and the light, you might move your fingers behind them, and ſee the motion thro' their bodies; after that theſe *Animalcula* had lain thus dried up for a day or two, in an oval or globular form, he poured ſome water into the glaſs-tube, whereupon they preſently ſunk to the bottom; and after the ſpace of about half an hour they began to open and extend their bodies, and getting clear of the glaſs, to ſwim about the water; excepting only, two of the largeſt that ſtayed longer on the ſides of the glaſs, before they ſtretched out their bodies, and ſwam away; after M. *Leewenhoeck* had poured the water from them, in order to ſee, how they brought their bodies into the above-mentioned orbicular form, viewing two of the largeſt of theſe *Animalcula* with a microſcope, he obſerved, that in the ſpace of a minute they ſtretch'd out their bodies ſeveral times to an extraordinary length, and thrice opened the hinder part of their bodies, and voided their *Fæces*, which in the little water that remained about them, were diſſolved into ſmall pellets, before they aſſumed their round figure.

Before the dirt and filth of the leaden-gutter was quite dried up, he took a handful thereof, and laid it on a glazed earthen diſh, in order to preſerve it; this foul ſtuff when dry is as hard as clay; ſo that the mites cannot come at the *Animalcula* that are thus doubly ſhut up; upwards of 21 months after, he took ſome of this dry ſtuff, and infuſed it both in cold water that had been boiled, and in rain-water newly fallen; whereupon the *Animalcula* began to ſhow themſelves, and that in great numbers; and ſoon after there appeared two ſorts of much ſmaller ones.

Several perſons converſant in tillage and grazing aſſur'd M. *Leewenhoeck*, that they had never known ſuch a plentiful year for graſs, as alſo for peaſe and beans, as was the ſummer enſuing, the great ſtorm in *November* 1703 (which M. *Leewenhoeck* aſcribes to the ſea-water being carried by the ſtorm over the meadows and orchards) and particularly, one that fattened *Daniſh* oxen, told M. *Leewenhoeck*, that he had a piece of ground, on which he fed 26 oxen; and that if he had turned 26 more into the ſame paſture, there would have been graſs enough for them; and that

he had never ſeen ſo much graſs before; and the oxen were alſo exceeding fat.

Obſervations on ſtaining *the* Fingers, *with a Solution of Silver in Aqua Fortis; by the Same.* Phil. Tranſ. N° 295. p. 1794.

M. *Leewenhoeck* took 24 ounces of mix'd metal, and putting the ſame into *Aqua fortis*, he ſet it on a ſand heat; and there being a defect in the glaſs, it crack'd; by which means ſome of the *Aqua fortis*, which was impregnated with ſilver, run into the ſand, and he does not know, but he might alſo have loſt gold therein; he got together as much of this ſand as was wet; and tho' he took all imaginable care, that the wet ſand ſhould not ſtick to his fingers, yet he ſaw that the tips of them were ſtained, ſo that with his naked eye he could ſee a diſcolouring of the ſkin; and as this happened in the evening, he waſhed his hands in common water, and next day he ſaw, that the tips of moſt of his fingers were black; he then took ſome freſh butter, to get the blackneſs off his hands and fingers, but how hard ſoever he rubbed them with the ſaid butter, it had no manner of effect; he afterwards took ſome ſoap, but all in vain; he rubb'd his thumb on a grind-ſtone with water and ſand, which leſſened the blackneſs a little, but did not take it quite off; the third day looking very attentively upon his black fingers, he reſolved to cut off ſome thin ſcales of the ſkin, no bigger than a fourth part of his nail, to ſee if he could get any ſilver out of it, that was perceptible; he laid theſe pieces on charcoal, ſuch as is uſed by the gold and ſilver-ſmiths, and blowing very gently with a pipe, the flame of a candle upon the ſaid ſmall particles of ſkin, which frying in the flame, a great many bubbles of air aroſe in them; and at laſt, driving more fire thereon, the ſkins were burnt, and the particles of ſilver, with which they were impregnated, remained, being melted into round globules, inſomuch that he judged that 1000 of the ſmalleſt could not form one large globule; and narrowly viewing ſome of the largeſt, he could ſee that they conſiſted of a great number of ſmall globules, which the fire was not ſtrong enough to diſſolve into a perfect roundneſs; theſe aboveſaid ſilver globules were not ſo large as to be ſeen with the naked eye; he repeated this operation the fourth day, after his hands had been ſo ſtained, and that with the ſame ſucceſs.

Plate XI. Fig. 30. A B C D E F G H I, repreſents the aforeſaid ſilver globules, as they appeared thro' the microſcope, and as

as they were joined to each other in melting; from whence it appears, that the fire was not hot enough to form them all into one globule, and they were no bigger than a coarſe grain of ſand.

Fig. 31. KLMNOPQ alſo repreſents ſome ſilver globules, which were melted in the fire, in the ſame form; and which alſo came out of a ſmall piece of ſkin, no bigger than the fourth part of his nail; that round part marked K L M, was alſo ſurrounded with a great many ſmall bubbles, that were all melted, but not ſo compleatly as to be joined in one.

M. *Leewenhoeck*'s middle finger, had a ſort of ſwelling that ſmarted when he ſqueezed it, at that place againſt which the pen leaned when he wrote; therefore, cutting off the ſwelling, and viewing it with a microſcope, he found that there was a ſmall roundneſs in the place, which he looſen'd as much as he could with a ſharp needle, and laying hold of it with a pair of tweezers he pulled a long particle out of the ſkin, about the thickneſs of a ſlender pin, and about 10 times as long as its diameter; it terminated in a point, and had at the root ſome ſmall veſſels or veins, out of which he perceived, that it received its nouriſhment; into the cavity of the ſkin, whence the ſaid thorn-like particle was extracted, he thruſt a little bit of *Roman* vitriol, and then he dropped a little water on the vitriol, that it might diſſolve, and kill the roots from whence this thorn-like particle ſprung; and tho' he repeated this ſeveral times, yet it grew in a few days again; hereupon he took ſome *Aqua fortis*, and letting a ſmall drop thereof fall into the cavity of the ſkin, it was no ſooner there, than it ſeemed as if it boiled, which was occaſion'd by the air bubbles that endeavoured to force their way out; as ſoon as the *Aqua fortis* had penetrated to the ſenſible part of the ſkin, it ſmarted a little, whereupon, he poured ſome common water on the place to weaken the *Aqua fortis*; but quickly after the thorn-like particle increaſed as before; he took *Aqua fortis* a ſecond time, and let it lie ſo long on the ſkin, that it ſmarted more than it did before; and ſince that time he did not perceive that particle to grow any more.

M. *Leewenhoeck* had a linen-handkerchief ſtained by *Aqua fortis*, impregnated with ſilver, with a black ſpot about the bigneſs of a ſhilling; after that this handkerchief had been waſhed 6 times, and laid to bleach, he cut out the black ſpot, and burnt it upon a bit of charcoal, and viewing thro' a microſcope what remained, he found that it conſiſted of ſeveral 1000 globules of ſilver, of an exceeding ſmallneſs.

Hyda-

Hydatides *voided by Stool*; *by Dr.* William Muſgrave. Phil. Tranſ. N° 295. p. 1797.

IN *April* 1704 Dr. *Muſgrave* was call'd to ſee one Mrs. *Pear* of *Tiverton*-town; ſhe was about 30 years of age, of a tender conſtitution, had a bad habit of body, and a fever the preceeding *Candlemaſs*, which continuing near three weeks, was at length overcome by teſtaceous powders, alexipharmics, but chiefly by the *Cortex*; in this fever ſhe had four vomitings, and a pain in her ſtomach, which continu'd a long time; and after the fever, it was accompanied with a plentiful ſalivation, together with *Flatus*'s and pains in her ſide, to an extraordinary degree, under all which the patient labour'd to the time of the Dr's ſeeing her; about three weeks before his viſit, ſhe was ſeiz'd with a jaundice, and whilſt ſhe was taking medicines; *viz. Pilulæ & Decoctum ictericum Fulleri*, for that illneſs, ſhe diſcharged ſeveral bladders by ſtool, and continu'd ſo to do, ſometimes every day, at other times once in two or three days, ever ſince the firſt diſcharge of this kind, to the time of the Dr's viſit; theſe bladders were of various ſizes; the leaſt that came off, was about the bigneſs of a large pin's head; the largeſt was equal to a pullet's egg; they were alſo of different colours; ſome were white, others more yellow, from the liquor contain'd in them, which was a ſort of jelly, like that of hart's horn, tinged more or leſs with ſaffron; before the diſcharge of theſe bladders, there was, beſides the ſymptoms already mention'd, a coldneſs and ſickneſs at her ſtomach, which was almoſt perpetual, with frequent inclinations to vomit, and hyſteric ſuffocations; ſince that diſcharge, theſe ſymptoms diſappear'd, and were ſucceeded by a ſoreneſs of the ſame part, as if ſomething had been torn there; the bladders were diſcharged without pain; ſeveral of them whole and entire, one of which the Dr. ſaw, that was about the bigneſs of a large gall, or marble ſtone; others were broken, and appear'd not unlike the empty ſkins of currants, gooſeberries and plumbs; one bladder only, and that a broken one, came away by vomiting; but to all appearance, it had been almoſt as large as a gooſe-egg; the jelly thrown up with this bladder, and which in all likelihood, had been contain'd therein, before it broke in coming up, was thicker and more fœtid, than what was found in any of the other bladders; the number of thoſe diſcharg'd by ſtool was very conſiderable; during the whole courſe of this illneſs, the patient was rather looſe than coſtive; had no manner of appetite, and ſeldom ſlept without an opiate; the Dr. found her much waſted in

fleſh,

fleſh, with a dead pale look, ſuch as argued her being very low; ſhe had ſtools of an unuſual ſtench, and no ways natural; and ſhe vomited a great deal of cold phlegm.

The patient believ'd, that theſe bladders proceeded from her ſtomach, and ſhe urged the following reaſons for her opinion: For, 1. Had theſe bladders been originally in her bowels, in all likelihood the purges (of which ſhe took ſeveral in the jaundice) would, as ſhe ſaid have carried them off much ſooner. 2. From the almoſt conſtant pain of her ſtomach, and frequent inclination to vomit, ever ſince her fever, to the time of diſcharging the bladders. 3. From the rawneſs and ſourneſs of her ſtomach, after the bladders were diſcharged. The Dr. thinks, that theſe reaſons may be eſteem'd to have force ſo far, as to prove that ſome, and perhaps a great number of theſe bladders proceeded from her ſtomach: There was no appearance in any one of theſe bladders, of ſuch an order of parts, or organs, as might ſhew them to be inſects; nor upon examination, was there any animal diſcern'd by the naked eye, in the liquor contain'd therein: The medicines adminiſtred, after the Dr. was call'd in, were chiefly of the vulnerary, and digeſtive kinds; that which did her moſt ſervice (but it was after the bladders were diſcharg'd) was the tincture of myrrh and gentian in large, and repeated doſes, in the proper vehicle; by the uſe of this medicine, from a very weak condition, ſhe recover'd her appetite, *&c.* and was afterwards perfectly well.

Worms *in the Heads of* Sheep, *&c*; *by Mr.* John Thorpe. Phil. Tranſ. N° 295. p. 1800.

IN diſſecting the head of a ſheep, there was found in the cells form'd between the *Laminæ* of the *Os Frontis*, a worm repreſented by Plate XI. Fig. 32. which was an *Epode* and ſeem'd to be a ſpecies of the *Eulæ*, tho' very different from the common ſort that breeds in putrid fleſh; it was all of a fair pale colour, excepting its tail, which terminated a little obliquely in a plane, on which there were two remarkable black ſpots; beſides two ſmall white *Corniculæ*; its head was armed with a pair of black ſharp and crooked *Forcipes*, which in contracting and dilating its body, it draws in and exerts at pleaſure; with theſe, in creeping it takes hold of the ſurface of the body on which it moves; and it draws itſelf forward in pretty large, protuberant, and ſomewhat flattiſh *Toruli* as in Fig. 33. fewer in number than thoſe on its back, which ſwelling and relaxing alternately, ſeem'd inſtrumental to its motion, and to ſupply the place of feet; it look'd

of

of a clear, cryſtalline ſubſtance, and almoſt tranſparent; the membrane, that inveſted the cavity of the cells containing this worm, was very fat, and in moſt places ſeparated from the bone; the blood-veſſels appear'd turgid, and inflam'd; whereas, the membrane of the oppoſite cells, which had no communication with theſe, was thin, pellucid, adherent, and no ways preternaturally affected.

Mr. *Bobart* inform'd Mr. *Thorpe*, that three worms were found lodged in the ſame parts of a ſheep's head, but in two diſtinct cells; the largeſt apart by itſelf, the other two in the adjoining cell; one of which was conſiderably leſs than the other, agreeing in form with the abovemention'd; of a whitiſh colour in general, with the two remarkable ſpots on the plane of the poſterior part; but there was a ſhade of brown from the back down the ſides, eſpecially, in the older one, roundly turgid on the back, and flat underneath, divided into ſeveral *Annuli*, as theſe animals generally are; at the extremity of theſe protuberances, which ſerve inſtead of feet, there appear'd a little darkiſh brown ſpot on each ſide or edge; as they faded and wither'd, they chang'd to a light red or *Phœnecian* colour, and afterwards became brown.

Mouffet mentions worms yearly breeding in the brains of ſtags, goats and ſheep, eſpecially when fat, but ſuppoſing them to be generally known, he gives no deſcription of them; unleſs from *Benedictus & Matthiolus*, that they are *Eulis maximis æquales, & ejuſdem cum illis formæ*; tho' the worms meant by both theſe authors are not found in the brain, but as both agree, *ſub linguâ in concavo circiter vertebram, quâ cervici innectitur Caput*: *Avicenna*, aſſerting the poſſibility of worms breeding in the head, ſays expreſsly, *multoties naſcuntur in anteriore parte Capitiis ſuper locum qui eſt in ſtrictura narium*; to which *Joubertus* adds, *ubi oves & capræ dicuntur perpetuò vermes habere, ut cervi in gutture:* This plainly ſhews the diſtinct places of their generating in the heads of ſtags and ſheep, as well as it deſcribes the particular cells, in which they are found in the *Os Frontis* of the latter.

Trallian relates a memorable ſtory from *Moſchion*; *Democrates* the *Athenian* applying himſelf to the oracle at *Delphos* for the epilepſy, receiv'd the following anſwer.

Μέιξον' ἀειραμεν'ος κεφαλῆς ποιμνιον ἐυλην
Μηκαδος ἀγρονομοιο, δερας περικαμ Βαλε μηλε
Ἑρπηλα πολυπλεκτον ἐυρινε ἀπο χορσης

Tran-

Tranſlated into *Latin* by *Guinterius Andernacus*, thus;

De Grege ſume capræ majores ruris alumnæ
Ex cerebro vermes, & ovis dato tergora circum
Multiplici vermi pecoris de fronte revulſo.

Democrates not comprehending the hidden meaning of the oracle, referr'd it to *Theognoſtes Democratius*; who recollecting that the head of a goat, near the baſis of the brain, is naturally impregnated with worms, very ſagely unfolded the myſtery; adviſing him, in purſuance to *Apollo*'s directions to procure one or three of them (for it ſeems it muſt be an odd number) by provoking the animal to ſneeze, and wear them about his neck in the ſkin of a black ſheep, as an amulet: It is not to be imagin'd, how worms ſeated at the baſis of the brain, where *Trallian* places them, ſhould be expell'd by ſternutatories; the words of the oracle Ευρινε απο κορυνε, admit of a more favourable conſtruction, and diſtinctly expreſs the cavity over the noſe; from whence by a paſſage, that opens into the palate and noſtrils, they may eaſily be diſcharged by ſneezing; and by the ſame paſſage they may as eaſily inſinuate themſelves, when ſmall; or rather, be drawn up with the breath, when they are in the ſtate of eggs, and be depoſited in theſe cells; where animated by the vital heat, and nouriſh'd by preying on the membrane, in which they are included, they may more probably occaſion the epilepſy in ſheep and goats, (a diſtemper *Hippocrates* obſerves to be frequently incident to theſe animals, tho' he aſcribes it to a different cauſe) than cure it in men: From hence, perhaps, we may be allow'd to account for thoſe various inſtances, given by medicinal authors, of worms ejected at the noſe by men and women; *Benivenius*, *Fernelius*, *Zacutus Luſitanus*, *Ronſſeus*, *Trincavellius*, *Hildanus*, *Baptiſta Codronchus*, *Tulpius Verzaſcha*, and others relate ſeveral caſes of this kind; all agreeing, that they were attended with extreme pains in the head, *Mania*'s *Lypothymies*, &c. which immediately ceas'd at their ejection.

It muſt be granted, that *Ægineta*, *Gabucinus*, *Foreſtus*, *Borellus*, and particularly, *Fulvius Angelinus*, who wrote an entire diſcourſe *de Verme admirando per nares egreſſo*, very rationally conclude, that the worms they treated of, proceeded from the ſtomach or lungs, by their not being attended with thoſe ſymptoms, nor affecting the head, as in the caſes related by the abovemention'd authors; particularly, in that remarkable inſtance of *Hollerius* of a worm evacuated at the noſe, *nullâ tuſſi, nullo vomitu*

antecedente; which by the acute pain it produced, plainly diſcovered where it lay conceal'd.

Whether worms may generate in the brain, or its integuments, Mr. *Thorpe* will not determine; it is ſufficient, ſuppoſing it poſſible, that there is no paſſage for them thence to the noſe, where they are often found, as we are aſſur'd by ſeveral credible authors; *Angelinus & Alſarius à Cruce* place them *propè naſi celatoria in ſtructurâ narium*; both ſeeming to imply that *Sinus*, which is more exactly deſcrib'd by *Avicenna*; and which is to be underſtood of human heads, not thoſe of brutes, but only as applied by *Joubertus:* What terrible ſymptoms, as *cephalæa's*, *deliriums*, *epilepſies*, *ſyncopes*, *convulſions*, &c. a worm, with ſuch ſharp and piercing weapons may cauſe, by continually preying, and ſporting on a part ſo exquiſitely ſenſible, and nearly ſituated to the origin of ſenſation, as the membrane that inveſts the cavity of this *Sinus*, may be more eaſily imagin'd than explain'd.

Large Stones *voided by the* Urethra; *by Dr.* Bullen. Phil. Tranſ. N° 294. p. 1804. *Tranſlated from the* Latin.

ONE *Thomas Olton*, who lived in the county of *Cheſhire*, upwards of 78 years of age, being grievouſly afflicted with the ſtone in the bladder, made frequent applications to Dr. *Bullen* and other phyſicians for their advice, who us'd ſeveral medicines according to the exigency of the caſe, but all to no purpoſe; but at length (the patient having taken an exceſſive quantity of honey during his pain, to which alone he himſelf attributed his deliverance) in one of his moſt ſevere fits, he voided by the *Urethra* two ſtones, of much the ſame ſhape and ſize; which being joined together, the circumference one way was above three inches and $\frac{1}{2}$, and the other way three and $\frac{1}{4}$: An almoſt intolerable pain accompanied the voiding of the firſt ſtone, but ſcarcely was there any at all felt at the coming away of the ſecond; which was owing to the *Urethra* being dilacerated by the former ſtone, whereby the latter had an eaſier paſſage; both theſe ſtones formed only one in the bladder, which was plain from their tallying, where they were broken off. *Schenkius* in his *Obſervat. cap. de calculo veſicæ* relates a ſimilar caſe.

An Experiment of firing Gun-powder, *on a red hot Iron in* Vacuo Boyliano; *by Mr.* Hauſkbee. Phil. Tranſ. N° 295. p. 1806.

THE red hot iron being included in a recipient proper for the purpoſe, and the air exhauſted (which was in about two minutes of time) the mercury then in the gauge ſtanding at 29 inches and ½, a quantity of gun-powder was immediately made to deſcend upon the iron, which continued on its ſurface ſome little time before it went off; and then it was obſerved not to fire all at once, and the laſt of the quantity that did ſo, ſeem'd to give the greateſt flaſh; upon which the mercurial gauge was obſerved to deſcend ſomething better than an inch, it riſing again ⅒ of the ſame; and upon ſeveral repetitions of the like quantity of gun-powder (the factitious air being always firſt exhauſted) the appearances were very ſimilar; again, upon exhauſting the factitious air out of the receiver, and the mercury being elevated in the gauge as at firſt, three quantities of powder were made to deſcend upon the iron, whoſe exploſion as well as the air produced from them, ſeemed to be in proportion to the quantity of powder, the mercury in the gauge then ſubſiding to 26 inches; but upon dropping ſix quantities (the receiver being firſt exhauſted as before) which not deſcending all at once, but ſucceſſively as faſt as poſſible, the quantities that firſt reached the ſtill ignited iron taking fire, by their flame made an exploſion of the whole, at once blowing up the recipient, tho' the weight of air incumbent thereon was equal to 144 pounds and ½, reckoning the receiver at three inches and ½ in diameter (but yet it was ſomething more) which is a ſufficient allowance for the want of height in the mercury; the gauge then ſtanding at 29 and ½, inſtead of 30, from which the calculation is made; the gun-powder made uſe of was the common glaz'd ſort; and the weight of the ſix quantities, which removed the recipient, with ſo great a preſſure incumbent thereon, was but ſeven grains, each quantity weighing ſomething better than a grain; Mr. *Hauksbee* did not obſerve that the receiver broke before it reached the floor; it was thick lin'd with ſulphureous aud nitrous ſteams, ſo that the flaſhes of fire thro' the cloudineſs of the glaſs ſeemed very much to reſemble faint lightning; the contents of the receiver was equal to about 25 ounces and ½ of water, allowing for the bulk of the iron and the pedeſtal.

An Experiment to try the Quality of Air *produced from* Gun-powder, *fired* in Vacuo Boyliano; *by the Same.* Phil. Tranſ. N° 295. p. 1807.

TO be ſatisfied, whether the factitious air of fired gun-powder is endued with any quality differing from common air, on *December* the 26th at noon Mr. *Hauksbee* included a red hot iron *in Vacuo*, the mercury in the gauge then ſtanding at 29 inches and $\frac{1}{2}$; upon dropping the firſt quantity of gun-powder, by which is to be underſtood ſomething more than a grain weight, its exploſion made the mercury in the gauge deſcend about an inch, undulating but very little; the ſecond quantity being let fall, the mercury ſubſided about $\frac{3}{4}$ of an inch; and ſo for ſeveral quantities following, it deſcended by pretty equal ſtages, till it had fallen about ſix or ſeven inches; and it was obſerved, that upon each quantity fir'd, the undulations of the mercury increas'd; but after it had ſubſided ſix or ſeven inches from 29 and $\frac{1}{2}$, its ſeveral deſcents became leſs, very little or nothing exceeding $\frac{1}{2}$ an inch, tho' the quantities fir'd were equal; but ſtill the undulations increas'd, and the exploſions manifeſtly did ſo too; till at laſt, the receiver ſeemed to be in great danger of being blown up by a ſingle quantity; the undulations of the mercury being then increaſed to ſix or ſeven inches: Now, that 26 quantities, or 32 grains had been fired upon the iron, and the mercury in the gauge fallen to 12 $\frac{3}{4}$, Mr. *Hauksbee* carefully obſerved the gauge, which in ſeven minutes had aſcended two inches $\frac{3}{4}$; the next five minutes it roſe but one $\frac{1}{4}$ of an inch, and ſo leſs every five minutes ſucceſſively; inſomuch, that in an hour and 17 minutes it had attained but to 21 inches, the iron not being quite cold; at nine the ſame night he obſerved the gauge, and found the mercury elevated to 22 inches and $\frac{1}{4}$ preciſely; next morning at nine it had attained to 22 and $\frac{1}{2}$, and ſo it continued all that day, the iron being then reduced to the temperature of the external air; ſo that from 12 and $\frac{3}{4}$ to 22 and $\frac{1}{2}$ ſeems to be the weight or ſpring of heat equal to about $\frac{1}{3}$ of an atmoſphere of air, which would preſs the mercury upon the upper part of the gauge, but equal to ſuch a degree of heat as was then contained in the receiver, when the gauge was fallen to 12 $\frac{3}{4}$; the remaining ſpace from 22 and $\frac{1}{2}$ to 29 $\frac{1}{2}$ is ſuppoſed to be ſupplied with factitious air, and anſwers to about $\frac{1}{4}$ part of the whole contents of the receiver, which was equal to 25 ounces and $\frac{1}{2}$ of common water, allowing for the iron and pedeſtal; Mr. *Hauksbee* found that this air produced from gun-powder, was

was actuated by heat and cold, as common air is; for holding his warm hands upon the receiver, the mercury in the gauge would immediately deſcend, and riſe again when reduced to the temperature of the external air; this he repeated ſeveral times with the like ſucceſs: What further occurs in this experiment, is why the exploſions of the like quantities of gun-powder ſhould be greater when reſiſted by air, than *in Vacuo*, where nothing ſeems to hinder the extenſion of their flame?

The vitrified Salts *of calcined* Hay; *by M.* Leewenhoeck. Phil. Tranſ. N° 296. p. 1856.

MR. *Chamberlayne* gave M. *Leewenhoeck* an account that a large hay rick on *Salisbury Plain*, after ſome reaking and fermentation, took fire, and was wholly conſumed; but that whereas the aſhes commonly lie looſe and ſcattered about, they were here condenſed into a firm, but very light ſubſtance, which was judged to be vitrified and calcined together by a particular heat, of which ſubſtance there were ſeveral cart-loads.

M. *Leewenhoeck* viewing a piece of the ſaid ſubſtance which was tranſmitted him by Mr. *Chamberlayne*, he ſuppoſed, that this vitrified matter was moſtly fixed ſalts, which becoming fluid by the great heat, the vapours or moiſture that aroſe from the bottom of the hay, or the particles thereof, which were not yet vitrified, had inſinuated themſelves into the fluid matter, and that upon the diminution of the heat, the ſaid vapours being congealed and impriſoned in the vitrified matter, was the cauſe of its lightneſs; as we find by experience, that a very ſmall particle of moiſture, when rarified by heat, poſſeſſes a much larger ſpace than it did before: For further ſatisfaction, whether it was not moſtly fixed ſalt, M. *Leewenhoeck* put about the bigneſs of a pea of this matter upon a piece of charcoal, on which he blew the flame of a thick candle, till the ſaid vitrified ſubſtance began to melt, and then he dropped it into a little copper-veſſel, wherein there was a very ſmall quantity of pure rain-water; this matter, with a little ſtirring diſſolved in the water like powder or brick-duſt; whereupon, he expected to find, that a great many ſalt particles would incorporate themſelves with the water; after the water had ſtood ſome minutes, he ſkimmed off ſome of the top, and placing it on 8 or 10 ſeveral very clear glaſſes, and not above a drop of water on each, he ſaw, when the water was very near evaporated, a great many ſalt particles remaining of various figures; amongſt which there were ſeveral whoſe ſuperficies was an exact ſquare, a few others were triangular, and others again were hex-

hexangular and long, which in proportion to their exceeding ſmallneſs, were very thick; ſo that they appeared to the naked eye, like little pieces of cryſtal, which was a very agreeable ſight; he moreover, ſaw long particles, but very few, which reſembled the ſmall particles of ſalt-petre; he alſo ſaw ſeveral particles which were broad in the middle, and narrow at both extremities; but he did not always ſee thoſe of this laſt ſort, which were ſo thin, that they appeared like ſhadows to his eyes; beſides the above-mentioned ſalt particles, there was a very great number of others, which were ſo ſmall, that he could not diſcover their figure; but thoſe that were a little larger than the reſt had ſome ſort of figure; from whence he concluded, that the remainder was alſo ſalt particles; beſides, where he ſaw one of theſe large ſalts (which was no bigger than the thouſandth part of a coarſe grain of ſand) lie, he could perceive no others round them for the ſpace of a hair's breadth; and as he could diſcover about the ſaid ſalt particles divers circles, which he judged to be coagulated ſalts, that by ſuch an acceſſion grew ſtill larger and larger; he was confirmed in his opinion, that the ſmall particles were moſtly ſalts; M. *Leewenhoeck* took a ſmall particle of the abovementioned vitrified matter, which had been before in a glowing heat, ready to melt and putting it again into a ſtrong fire, when melted, it began to change itſelf into a globular figure, whereupon ſeveral air-bubbles appeared one after another, forcing themſelves a paſſage, which ſhut up again after they were broken out; and this he continued till the matter became perfectly globular.

M. *Leewenhoeck* asking a certain perſon who had a hay-rick, (containing upwards of 100 loads, and each load 1000 weight) burnt down, what there remained on the ground where it ſtood? Who anſwered, a light glazy ſtuff, very brittle, which upon walking over it cracked and broke under his feet, and upon putting a little of it into his mouth, he could perceive a ſaltneſs therein: This countryman told M. *Leewenhoeck*, that there is great danger of ſuch hay-ricks taking fire, if put up before the hay is dry; and he gave an inſtance of one, tho' it did not break out into a flame, yet it ſmoaked very much; and being pulled down, when they came to the middle of it, they found ſome of the hay burnt, and ſome part thereof was clear aſhes, together with a ball of vitrified matter; but he added, that the fire was quenched as he ſuppoſed for want of air.

Inſect

Inſects *in the* Bark *of decaying* Elm *and* Aſh-trees; *by Sir* Matthew Dudley. Phil. Tranſ. N° 296. p. 1859.

SIR *Matthew Dudley* had tranſplanted divers elms, upwards of ſix inches diameter, which for the firſt two or three years thrived very well; but there happening a very dry ſeaſon in *July* or *Auguſt*, he obſerved, that one of thoſe elms, which ſtood very ſhallow, and on pretty high ground, looked very ſickly; its leaves became yellow, and began to fall off, which made him examine the bark with a knife; when he found, that the inſide thereof was not ſo green, but of a more reddiſh colour than the reſt were; and between it and the tree it was not ſo moiſt, the bark ſticking very cloſe to the wood; but what was moſt remarkable, he diſcovered a great many ſmall black flies of the beetle-kind (having a hard caſe or membrane, under which their thin long wings were contracted and thereby covered) between the bark and the tree; and viewing it more narrowly, he obſerved, that theſe flies had made their way thither by perforating the bark in a vaſt many places; and the holes were eaſily diſcernible on the outſide, which were as big as that a large pin's-head could enter them; he found ſome of the flies juſt entering, and which had not got quite thro' the bark; others, had made ſome progreſs between the tree and the bark, which appeared like a channel; Sir *Matthew* deſpaired of ever recovering the tree; however, he cauſed his ſervants to pour about two hogſheads of water thereon, and ſtir the earth about the roots, and lay ſome rotten litter thereon, to defend it from the ſcorching rays of the ſun; upon this, the tree recovered again in ſome meaſure its verdure that year, and next year it yielded very good ſhoots, and ſo it continued, till ſome ſhort time after, that there happened a very dry ſummer, when Sir *Matthew* obſerved divers of his trees look ſickly in the beginning of *Auguſt*, and particularly the above-mentioned one; and making the ſame tryal on them all, he found the bark ſtuck cloſe to the wood, with very little moiſture between them, and vaſt numbers of thoſe ſmall flies, which had pierced the bark in a great many places; he ordered the earth about the roots to be looſened as formerly, and about two hogſheads of water to be poured on each; and viewing them next morning, he found the outſide of the trees almoſt covered with bees, waſps, and large black flies, commonly called fleſh-flies, who were all buſy in ſucking the juice or ſap (which ran plentifully out at every hole, that the above-ſaid ſmall flies had made in the bark) which was very glutinous, and as ſweet as honey; he again examined the bark

bark, between which and the wood he found it very moiſt, and all thoſe little flies either gone or drowned in their new habitations, by the ſudden riſe of the ſap; and the ſaid tree recovered: Upon examining ſeveral trees that looked more ſickly than the reſt, he found that there was hardly any greenneſs left in the bark, and that there remained no moiſture between it and the wood; but the bark ſtuck ſo cloſe to the wood, that it could hardly be ſeparated therefrom; and the bark throughout the whole tree was pierced by the aforeſaid flies; each of which made from the hole, where it entered a ſtreight perpendicular channel upwards, about two inches long or ſomething better, very little, if at all, larger than juſt to move themſelves forwards in; for he obſerved that all of them, if diſturbed, came out backwards; there were ſmall channels, as cloſe to each other as they poſſibly could, yet ſo as to be diſtinct, running horizontally all along on each ſide this channel, at the extremity of every one of which there was a maggot, exactly of the ſame ſize therewith, very lively, whitiſh and almoſt tranſparent; theſe trees tho' well watered, received no benfit thereby, but died: It is to be obſerved, that there were none of theſe flies to be found in ſuch trees whoſe leaves looked green and healthful; the reaſon of which Sir *Matthew* ſuppoſes to be this, that whilſt there was a ſufficient moiſture in the earth about the roots, to ſupply the tree with a due quantity of ſap, ſo thin and diluted that it was proper and capable of being conveyed into the ſmalleſt twigs and leaf-veſſels, the leaves retained their verdure, and the tree flouriſhed; but when by reaſon of the dry ſeaſon, that ſupply failed, and the ſun perpetually exhaled the thinner and more watry parts thereof, thro' the bark, the ſap already in the tree became inſufficient in quantity, as well as improper, by reaſon of its thickneſs, to ſupply or enter into all thoſe ſmall veſſels; the leaves loſt their greenneſs, and fell off, and the ſap became thick and very ſweet (which he found it is not, when it is duly diluted, and when the tree is healthful) which invited thoſe flies to make their way to it, as a proper nurſery to bring up their young ones, which Sir *Matthew* takes thoſe little maggots to be; he alſo ſuppoſes, that the eggs were firſt laid in the large channel (and perhaps, regularly depoſited at their proper diſtances, in the ſides thereof) and after being hatched, made thoſe ſmall channels themſelves, ſince they are no ways capable of receiving the old fly; and that the maggot is always found at the fartheſt extremity of the little channel, and the reſt of it is quite filled with very ſmall particles, which when dry, become a fine powder; and Sir *Matthew* ſuppoſes it

to be either the excrement of the worm, or particles of the bark ground ſmall by the teeth of the worm, to make its way forwards, and rejected as not being proper aliment, or both; about the middle of *October* he found that theſe little white maggots, and conſequently their channels, which they exactly filled, were grown much larger, and had made their progreſs from the place where they were firſt hatched, which was cloſe to, or upon the very wood, almoſt to the very outſide of the bark of the elm, which is uſually pretty thick; and in every one of thoſe perpendicular channels above-mentioned, he found the mother-fly lying dead, for the moſt part towards the entrance of the ſaid channel.

From theſe obſervations Sir *Matthew Dudley* was led to view the fuel that lay on the ground in his yard; and in all the elms which were felled laſt ſpring, he found that the bark thereof was as much perforated; and that the ſame mother-channels and the little channels proceeding therefrom, were full of maggots, which had alſo made their way almoſt to the outſide of the bark; obſerving ſome elms that had lain much longer in the yard, and taking off the bark, he found the ſame tracts both of the mother-flies and maggots; and that at the extremities of almoſt all the channels formed by the maggots, where they had ſubſiſted long enough to come to perfection, the bark was perforated quite thro' by a hole juſt the bigneſs of the channel, and nothing left remaining but a ſort of whitiſh pellicle, pretty tough, exactly of the colour and ſize of the maggot, at the entrance of the hole; and the reſt of the forſaken channel was quite filled with what Sir *Matthew* calls the excrement of the maggot: Then examining the aſh-wood, which had lain ſometime in the yard, it being young and its bark pretty ſmooth, he at firſt ſight perceived it full of ſmall holes, and upon ſeparating it from the tree, he found juſt the ſame ſort of work, as in the elm, and by the ſame ſort of fly, having obſerved ſeveral of the mother-flies dead in their channels, as alſo the ſame empty ſkins or membranes at the extremities of the other channels; only with this difference, that whereas, in the elm all the mother-channels were perpendicular, and the maggot-channels horizontal, here in the aſh it was juſt the contrary; this Sir *Matthew* took at firſt to be accidental, and peculiar to that piece of wood; but upon examining upwards of 100 pieces of different trees, and felled at different times, he found that it held exactly true in them all; he obſerved ſeveral oak and maple trees, ſome of which had been felled in winter, and others in ſummer,

and the bark remaining thereon, but he could find no ſuch thing in either of them.

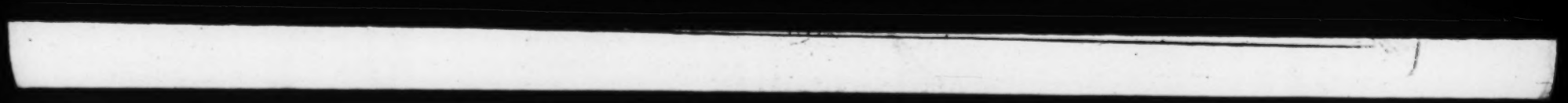
Plate XII. Fig. 1. repreſents the bark of the aſh. Fig. 2. the bark of the elm. Fig. 3. the worm as big as the life, lying on its back. Fig. 4. the mother-fly as big as the life, with its belly upward. Fig. 5. and 6. the worm and fly with their backs upward. Fig. 7. and 8. the worm magnified. Fig. 9. the mother-fly magnified.

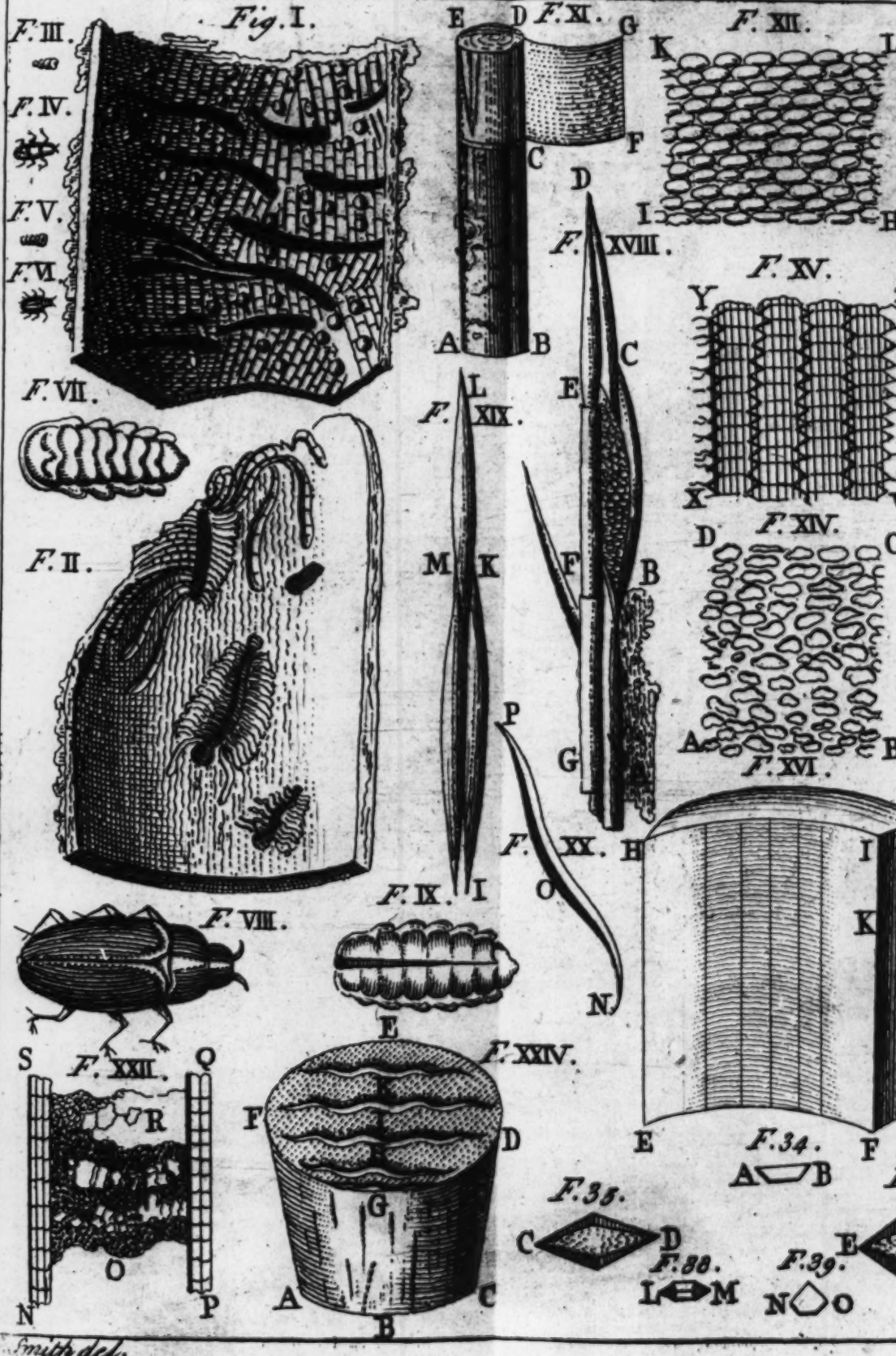
A Leaden Coffin *found in a* Roman *Burying-place, near* York; *by Mr.* Ralph Thoresby. Phil. Tranſ. N° 29 p. 1864.

AT *York*, without *Boutham-bar*, was found in the *Roman* burying-ground, a remarkable leaden-coffin, which by the circumſtances ſeems to have been for a perſon of quality; it was nine foot deep in the ground, whereof ſix were clay and three black earth; the leaden-coffin which was about ſeven foot long, was incloſed in a vaſtly ſtrong one, made of oak-planks, about two inches and ½ thick, which beſides the rivettings, were tacked together with brags, or large iron-nails, ſome of which Mr. *Thoresby* pulled out of the planks and had them by him; they were four inches long, the heads not die-wiſe, as large nails now are, but quite flat, and an inch broad; he alſo had another nail ſomewhat different, being ½ an inch broad, and thin, ſomewhat in the form of a wedge, the head was not round as the others, but ſomething like the modern draw-nails; but theſe old ones were generally ſquare, the four ſides being of an equal breadth; ſeveral of them were almoſt conſumed with ruſt; the outſide of the planks was rotten, but the heart of the oak was ſound, and the lead was very freſh and pliable; whereas one that was found a year before this (whereof Mr. *Thoresby* had alſo a ſample) was brittle and almoſt entirely conſumed, having had no planks to defend it; but what was moſt ſurpriſing was that the bones ſhould be entire, tho' probably interred 150 years ago; for it is above ſo many centuries, ſince the cuſtom of burning gave place to that more natural one of burying the dead, which according to M. *Murer*, was re-introduced by the *Antonines*.

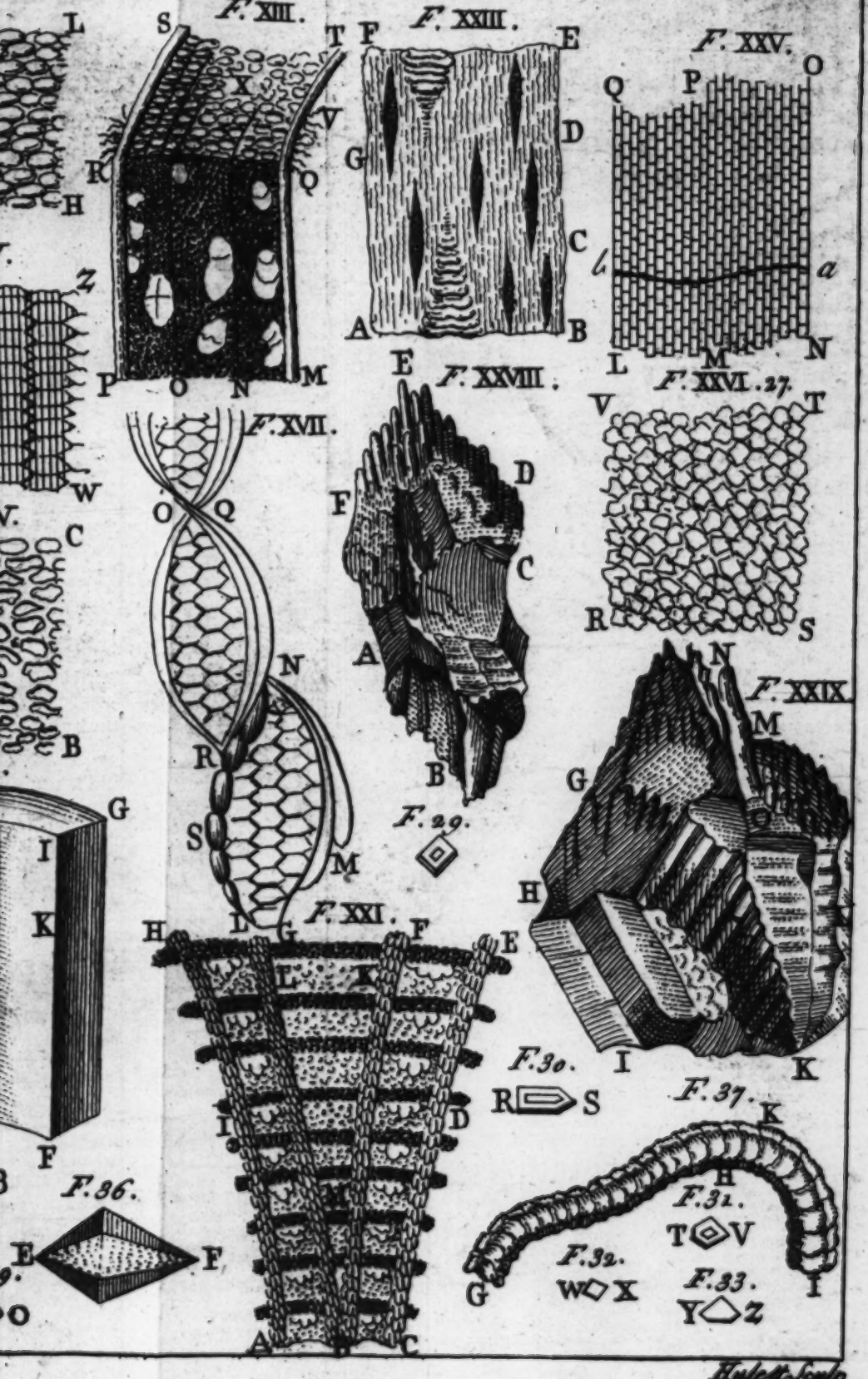
Mr. *Thoresby* had a thigh-bone, which was exceeding light, as alſo a lower jaw-bone, which had all the teeth; but tho' the bones were light, the double coffin was ſo heavy, that they were obliged to drag it out of its old dormitory with a team of horſes.

E




Fig. I.
F. III.
F. IV.
F. V.
F. VI.
F. VII.
F. II.
F. VIII.
F. XI.
E D
G
F
C
A B
F. XII.
K
I
H
F. XVIII.
D
C
E
F. XV.
Y
X
F. XIV.
D
A
F. XVI.
F. XIX.
L
M K
F
B
P
G
F. XX.
H
O
N
F. IX.
I
E
F. XXIV.
F
D
G
A
C
B
F. XXII.
S
Q
R
O
N
P
I
K
E
F
F. 34.
A B
F. 35.
C
D
F. 38.
L M
F. 39.
E
N O

Smith del.


F. XIII.
F. XXIII.
F. XXV.
F. XXVIII.
F. XXVI. 27.
F. XVII.
F. XXIX
F. 29.
F. XXI.
F. 30.
F. 37.
F. 36.
F. 31.
F. 32.
F. 33.
Hulett Sculp

Experiments *on the production and propagation of Light from the* Phoſphorus in Vacuo; *by Mr.* Francis Hauksbee. Phil. Tranſ. N° 296. p. 1865.

Exp. I. MR. *Hauksbee* having provided a dark room, drew ſome lines on a piece of blue paper with the *Phoſphorus*, which became immediately luminous in the open air, having a continual undulating motion, this being placed under a receiver, after ſome few exhauſtions, the undulation ceaſed, but the luminous quality appeared to be in a great meaſure increaſed; the receiver being further exhauſted, it became manifeſtly brighter; and ſo continued, till on the admiſſion of air (which was gradually done) the light diminiſhed ſenſibly all the while; but upon the repetition of the experiment, the gentlemen who ſaw it were of opinion, that it did not appear altogether ſo briſk, or ſo vivid as at firſt.

Experiment II. To two or three pieces of *Phoſphorus* in a glaſs diſh was added a ſmall quantity of oil of vitriol, tartar *per deliquium*, and oil of cloves, which mixture fired the *Phoſphorus* in the open air; but upon adding a little common water, the flame was extinguiſhed; this preparation being included in a receiver, very little light appeared; but upon exhauſting the air, it became very apparent, and emitted vivid ſteams; at the ſame time the ingredients in the diſh very much reſembled a boiling flame, exhibiting a ſtrong light; ſo that ſeveral objects near it were thereby diſtinguiſhable, and continued ſo, till the air was re-admitted, at which time it became opaque; nor would ſhaking the engine (by which means the mixture in the diſh was put in motion) produce any ſenſible recovery of light.

Experiment III. A ſmall quantity of the above-mentioned ingredients being put into a bottle with a narrow neck, and included under a receiver, it then appeared with very little light; but upon exhauſting the air, the *Phoſphorus* began to be luminous, and continued to increaſe, in proportion to the rarifaction of the air, iſſuing out of the bottle in a pyramidal form; at laſt, notwithſtanding the receiver was well exhauſted, the vivid ſteams that were then emitted were ſo fine and ſubtile as to aſcend in ſo thin a *medium*, reaching the upper parts of the receiver (which was not tall) and deſcending again by the ſides thereof; upon letting in the air, the light quite vaniſhed; and it would have been to no purpoſe (as Mr. *Hauksbee* often tried) to have waited in expectation of its recovery in the open air.

Pewter Money *coined in* Ireland; *by Mr.* Thoresby. Phil. Tranſ. N° 297. p. 1875.

MR. *Thoresby* had a crown piece of pewter, of the late king *James*'s *Iriſh* coin, inſcribed *melioris teſſera fati*, which was ſent him by one Mr. *Putland*, who found it in the treaſury at *Dublin*, and whoſe account of it is as follows; *viz.* 'That king 'James, having turned all the braſs guns of *Ireland*, and all 'the braſs, and copper-veſſels of *Proteſtants*, that he could ſeiſe 'into coin; that is, half-crowns, ſomewhat bigger than an *Eng-* 'liſh half-penny, ſhillings broader, but not ſo thick as a far- 'thing, and ſix-pences in proportion; it was ordered, that they 'ſhould paſs current in all payments, even in bonds, and diſcharge 'of judgments and ſtatutes; ſo that men abſconded, to avoid 'receiving their debts; but this ſtock of metal being all ſpent '(which he began to coin in *June* 1689) and their being no cir- 'culation to bring them back into his treaſury, he call'd in all 'that he had coin'd; and the half-crowns, which before were 'ſtamped with a face, were re-ſtamped with his effigies on horſe- 'back, and then paid out to thoſe who brought them in, as 'crowns; and the ſmaller coins were melted down, and re-coined 'again under the ſame denominations, but with leſs metal; after 'the turn was ſerved by this ſtratagem, he had not wherewithal 'to import copper and braſs; but for want of it, fell foul on the 'pewter diſhes, *&c.* and the piece I ſent you was coined for five 'ſhillings, and the proclamation to make it paſſable was ready 'prepared; but king *William* paſſing the *Boyne*, prevented 'their proclaiming it'.

This valuable curioſity has the ſame inſcription on both ſides, as the common braſs-crowns; but there is this legend added on the rim of it, MELIORIS TESSERA FATI ANNO REGNI SEXTO.

A Synopſis *of the Aſtronomy of* Comets; *by Mr.* Edm. Halley. Phil. Tranſ. N° 297. p. 1882. *Tranſlated from the* Latin.

THE ancient *Egyptians* and *Chaldeans* (if we may credit *Diodorus Siculus*) being furniſhed with a long ſeries of obſervations, could predict the riſing, or appearing of comets; but as they alſo are ſaid by the ſame arts to have foretold earthquakes and tempeſts, it is paſt all doubt, that their knowledge in theſe matters was rather the reſult of aſtrological calculations, than of aſtronomical theories of the motions of the celeſtial bodies;

dies; and the *Greeks*, who were the conquerors of both theſe nations, ſcarcely found any other ſort of learning amongſt them than this; ſo that it is to the *Greeks* themſelves, as the inventors, eſpecially to the great *Hipparchus*, that we owe this aſtronomy, which is now ſo greatly improved; but yet *Ariſtotle*'s opinion (*viz.* that comets were nothing elſe but ſublunary vapours or airy meteors) prevailed ſo far amongſt the *Greeks*, that this ſublimeſt part of aſtronomy lay altogether neglected; ſince none could think it worth while to obſerve, and give an account of the wandering and uncertain paths of vapours floating in the *Æther*; whence it is, that we have nothing certain handed down from the ancients concerning the motion of comets; but *Seneca* the philoſopher, conſidering the *Phænomena* of two remarkable comets of his time, made no ſcruple to place them amongſt the celeſtial bodies, taking them to be ſtars of equal duration with the world itſelf; tho' he owns, that their motions were regulated by laws not then diſcovered; at length, he foretels (which has proved no vain prediction) that time and diligence would unfold theſe myſteries to ſome future ages, who would be ſurpris'd to find the ancients could be ignorant of them, after that ſome lucky interpreter of nature ſhould have pointed out in what parts of the heavens comets wandered, and ſhewn what, and how great they were; yet moſt aſtronomers differed from *Seneca* in this; and *Seneca* himſelf has not left any account of the *Phænomena* of their motion, whereby he might ſupport his hypotheſis, nor aſſigned the time of their appearing, which might enable poſterity to determine any thing in this matter: So that after Mr. *Halley* had turned over ſeveral hiſtories of comets, he could find nothing at all, that could give any aſſiſtance herein, before *A. D.* 1337, when *Nicephorus Gregoras* an hiſtorian and aſtronomer of *Conſtantinople* had pretty accurately deſcribed the path of a comet amongſt the fixed ſtars; but he too looſely aſſigns the time, ſo that this undetermined comet only deſerves to be inſerted in the catalogue, on account of its having appeared almoſt 400 years ago; the next comet *A. D.* 1472, which moved the ſwifteſt of all, and came neareſt to the earth was obſerved by *Regiomontanus*; this comet (ſo frightful on account both of the magnitude of its body and its tail) in the ſpace of a day moved 40° of a great circle in the heavens, and it is the very firſt of which, any proper obſervations have been handed down to us; for all thoſe who conſidered comets before *Tycho Brahe*, that great reſtorer of aſtronomy, ſuppoſed them to be below the moon, and ſo took but little notice of them, imagining them to be

no

no other than vapours: But in the year 1577, *Tycho Brahe* applying himſelf ſeriouſly to the ſtudy of aſtronomy, and having procured large inſtruments for making celeſtial menſurations, with greater exactneſs and certainty than the ancients could ever hope for; there appeared a pretty remarkable comet, to the obſervation of which *Tycho* vigorouſly applied himſelf, and he found by ſeveral unqueſtionable trials, that it had no ſenſible diurnal parallax; and conſequently, that it was not only no aerial vapour, but much higher than the moon; nay, and might be reckoned amongſt the planets for any thing that appeared to the contrary, notwithſtanding the cavilling oppoſition of ſome ſchoolmen; to *Tycho* ſucceeded the ſagacious *Kepler*, who having the advantage of *Tycho*'s obſervations, found out the true and phyſical ſyſtem of the world, and vaſtly improved aſtronomy; for he demonſtrated, that all the planets revolved in planes paſſing thro' the center of the ſun, and deſcribed elliptical curves, obſerving this law, that the area's of the elliptic ſectors taken at the center of the ſun, in the *Focus* of the ellipſis, are always proportional to the times, wherein the correſpondent arches are deſcribed; he alſo diſcovered, that the diſtances of the planets from the ſun are in the ſeſquialteral ratio of their periodical times, or that the cubes of the diſtances are as the ſquares of the times; this great aſtronomer had the opportunity of obſerving two comets, one of which was very remarkable; and from his obſervations of theſe, he concluded, from ſeveral indications of an annual parallax, that comets move freely thro' the planetary orbits, with a motion not much different from a rectilinear one, but which he could not then determine: Next *Hevelius*, a noble emulator of *Tycho*, following *Kepler*'s ſteps, embraced the ſame hypotheſis of the rectilinear motion of comets, he himſelf having very accurately obſerved ſeveral of them; yet he complained, that his calculations did not altogether agree with the appearances in the heavens, and he was aware that the path of comets was incurvated towards the ſun: At length, that extraordinary comet of 1680 deſcended from a vaſt diſtance, and as it were, in a perpendicular line towards the ſun, and aſcended from him again with an equal velocity; this comet appearing conſtantly for four months, by the peculiar and remarkable curvity of its orbit, ſeemed above all others the moſt adapted for inveſtigating the theory of their motion; and the Royal obſervatories at *Paris* and *Greenwich* being founded ſome time before, and committed to the care of the moſt famous aſtronomers, the apparent motion of this comet was (as far as human ſagacity could reach) very accu-

accurately obſerved by M. *Caſſini* and Mr. *Flamſtead*: Not long after, that incomparable geometrician Sir *Iſaac Newton*, not only demonſtrated that what *Kepler* had found, did neceſſarily obtain in the planetary ſyſtem, but likewiſe that all the *Phænomena* of comets plainly follow from the ſame principles, which he fully illuſtrated by the above-mentioned comet of 1680; and at the ſame time ſhewed the method of geometrically conſtructing the orbits of comets, and to the ſurpriſe of all men, ſolved a problem, whoſe intricacy rendered it worthy of ſo great a genius; and he proves that this comet revolved round the ſun in a parabolic orb, in ſuch a manner that the areas eſtimated at the centre of the ſun were proportional to the times: Mr. *Halley* purſuing the ſteps of ſo great a man, attempted (and he preſumes not without ſucceſs) to bring the ſame method to an arithmetical calculation; for having collected together all the obſervations of comets, he obtained the following table, the reſult of an almoſt immenſe calculation.

The following table needs no explication, ſince the titles ſufficiently expreſs what the numbers mean; but the perihelion diſtances are eſtimated in ſuch parts, of which the mean diſtance of the earth from the ſun contains 100000.

of the Com.	Node. Ascend.				the. Orbit.			Orb.			Eclip.			Perihel.			Dist. from the Sun	of the Perih. from the Sun	Perihel. at London.		
		gr.	′	″	gr.	′	″		gr.	′	″		gr.	′	″		gr.			day	h.	′
1337	♊	24	21	0	32	11	0	♉	7	59	0	♉	12	45	15	22	40	30	N	40666	9. 609236	*June*	2	6	25
1472	♍	11	46	20	5	20	0	♉	15	33	30	♉	15	40	20	4	25	50	S	54273	9. 7345 4	*Feb.*	28	22	23
1531	♉	19	25	0	17	56	0	♒	1	39	0	♒	0	48	15	17	3	05	N	56700	9. 753583	*Aug.*	24	21	18½
1532	♊	20	27	0	32	36	0	♋	21	7	0	♋	16	59	40	15	57	00	N	50910	9. 706803	*Oct.*	19	22	12
1556	♏	25	42	0	32	6	30	♍	8	50	0	♍	11	6	00	31	10	20	N	46390	9. 666424	*Apr.*	21	20	23
1577	♈	25	52	0	74	32	45	♌	9	22	0	♏	7	53	00	69	35	20	S	18342	9. 263447	*Oct.*	26	18	45
1580	♈	18	57	20	64	40	0	♋	19	5	50	♋	19	17	10	64	40	0	N	59628	9. 775450	*Nov.*	28	15	00
1585	♉	7	42	30	6	4	0	♈	8	51	0	♈	8	59	10	2	55	25	S	109358	0. 038850	*Sept.*	27	19	20
1590	♏	15	30	40	29	40	40	♎	6	54	30	♎	2	55	50	22	45	50	S	57661	9. 760882	*Jan.*	29	3	45
1596	♒	12	12	30	55	12	0	♎	18	16	0	♎	22	44	35	54	44	30	N	51293	9. 7100 58	*July*	31	19	55
1607	♉	20	21	0	17	2	0	♒	2	16	0	♒	1	29	40	16	10	5	N	58680	9. 768490	*Oct.*	16	3	50
1618	♊	16	1	0	37	34	0	♈	2	14	0	♈	6	10	00	35	50	0	S	37975	9. 579498	*Oct.*	29	12	23
1652	♊	28	10	0	79	28	0	♈	28	18	40	♊	10	41	35	58	14	0	S	84750	9. 928140	*Nov.*	2	15	40
1661	♊	22	30	30	32	35	50	♋	25	58	40	♋	21	37	30	17	17	0	N	44851	9. 651772	*Jan.*	16	23	41
1664	♊	21	14	0	21	18	30	♌	10	41	25	♌	8	40	35	16	1	50	S	102575½	0. 011044	*Nov.*	24	11	52
1665	♎	18	02	0	76	05	0	♊	11	54	30	♉	24	6	35	23	8	0	N	10649	9. 027309	*Apr.*	14	5	15½
1672	♍	27	30	30	83	22	10	♉	16	59	30	♋	9	26	00	69	27	40	N	69739	9. 843476	*Feb.*	20	8	37
1677	♎	26	49	10	79	03	15	♌	17	37	5	♋	16	21	05	75	44	10	N	28059	9. 448072	*Apr.*	25	00	37½
1680	♍	2	2	0	60	56	0	♐	22	39	30	♐	27	26	50	8	11	10	S	00612½	7. 787106	*Dec.*	8	00	6
1682	♉	21	16	30	17	56	0	♒	2	52	45	♒	2	0	30	16	59	20	N	58328	9. 765877	*Sept.*	4	07	39
1683	♏	23	23	0	83	11	0	♊	25	29	30	♋	10	36	55	82	52	00	N	56020	9. 748343	*July*	3	2	50
1684	♐	28	15	0	65	48	40	♎	28	52	0	♐	15	15	25	26	35	20	S	96015	9. 982339	*May*	29	10	16
1686	♓	20	34	40	31	21	40	♊	17	00	30	♊	16	24	00	31	17	35	N	32500	9. 511883	*Sept.*	6	14	33
1698	♐	27	44	15	11	46	0	♍	00	51	15	♍	0	47	20	0	38	10	S	69129	9. 839660	*Oct.*	8	16	57

A general Table to compute the Motion of Comets in a parabolic Orbit.

mean Mot.	Angle from Perihel.			Log. dist. from the Sun.	mean Mot.	Angle from Perihel.			Log. dist. from the Sun.
°	gr.	′	″		°	gr.	′	″	
1	1	31	40	0. 000077	31	42	55	07	0. 062400
2	3	3	15	0. 000209	32	44	3	16	0. 065835
3	4	34	43	0. 000694	33	45	10	26	0. 069316
4	6	6	0	0. 001231	34	46	16	35	0. 072839
5	7	37	1	0. 001921	35	47	21	36	0. 076396
6	9	7	44	0. 002759	36	48	25	33	0. 079984
7	10	38	2	0. 003745	37	49	28	29	0. 083604
8	12	7	35	0. 004876	38	50	30	23	0. 087249
9	13	37	17	0. 006151	39	51	31	11	0. 090912
10	15	6	6	0. 007564	40	52	30	54	0. 094594
11	16	34	20	0. 009115	41	53	29	42	0. 098298
12	18	1	54	0. 010798	42	54	27	32	0. 102019
13	19	28	47	0. 012609	43	55	24	22	0. 105752
14	20	54	53	0. 014550	44	56	20	11	0. 109490
15	22	20	14	0. 016607	45	57	15	5	0. 113240
16	23	44	43	0. 018783	46	58	9	2	0. 116995
17	25	8	22	0. 021072	47	59	2	5	0. 120756
18	26	31	7	0. 023470	48	59	54	13	0. 124518
19	27	52	55	0. 025969	49	60	45	26	0. 128278
20	29	13	52	0. 028551	50	61	35	45	0. 132035
21	30	33	39	0. 031263	51	62	25	14	0. 135792
22	31	52	31	0. 034045	52	63	13	50	0. 139541
23	33	10	23	0. 036916	53	64	1	38	0. 143288
24	34	27	12	0. 039864	54	64	48	38	0. 147029
25	35	42	59	0. 042892	55	65	34	50	0. 150762
26	36	57	41	0. 045989	56	66	20	14	0. 154482
27	38	11	20	0. 049154	57	67	04	51	0. 158192
28	39	23	56	0. 052383	58	67	48	22	0. 161890
29	40	35	26	0. 055668	59	68	31	51	0. 165578
30	41	45	50	0. 059010	60	69	14	16	0. 169254

of the Com. | Node. Ascend. | tha. Orbit. | Ork. | Eclip. | Perihel. | Dist. from the Sun. | of the Perih. from the Sun. | Perihel. at London.

A general Table to compute the Motion of Comets in a parabolic Orbit.

Mean Mot.	Angle from Perihel.			Log. diff. from the Sun.	Mean Mot.	Angle from Perihel.			Log. diff. from the Sun.
°	gr.	′	″		°	gr.	′	″	
61	69	55	58	0. 172914	91	86	20	34	0 27417
62	76	36	50	0. 176557	92	86	46	20	0. 277239
63	71	17	16	0. 180188	93	87	11	43	0. 280284
64	71	56	56	0. 183803	94	87	36	45	0. 283306
65	72	35	57	0. 187404	95	88	01	27	0. 286308
66	73	14	15	0. 190978	96	88	25	49	0. 289293
67	73	51	59	0 194540	97	88	49	48	0. 292252
68	74	29	6	0. 198085	98	89	13	32	0. 295201
69	75	05	38	0. 201614	99	89	36	54	0. 298122
70	75	41	35	0. 205122	100	90	00	00	0. 301030
71	76	16	56	0. 208612	102	90	45	14	0. 306782
72	76	51	43	0. 212080	104	91	29	18	0. 312469
73	77	25	57	0. 215529	106	92	12	14	0. 318066
74	77	59	41	0. 218963	108	92	54	4	0. 323587
75	78	32	54	0. 222378	110	93	34	52	0. 329042
76	79	5	35	0. 225769	112	94	14	40	0. 334424
77	79	37	45	0. 229142	114	94	53	30	0. 339736
78	80	9	23	0. 232488	116	95	31	22	0. 344979
79	80	40	34	0. 235809	118	96	8	22	0. 350153
80	81	11	16	0. 239127	120	96	44	30	0. 355262
81	81	41	31	0. 242416	122	97	19	48	0. 360306
82	82	11	19	0. 245684	124	97	54	17	0. 365284
83	82	40	40	0. 248933	126	98	28	00	0. 370200
84	83	9	34	0. 252159	128	99	00	57	0. 375052
85	83	38	4	0. 255366	130	99	33	11	0. 379842
86	84	6	8	0. 258552	132	100	4	43	0. 384576
87	84	33	49	0. 261720	134	100	35	45	0. 389252
88	85	1	5	0. 264865	136	101	5	48	0. 393868
89	85	27	58	0. 267989	138	101	35	22	0. 398428
90	85	54	27	0. 271092	140	102	4	19	0. 402930

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A general Table to compute the Motion of Comets in a parabolic Orbit.

mean Mot.	Angle from Perihel.			Log. dist. from the Sun.	mean Mot.	Angle from Perihel.			Log. dist. from the Sun.
○	gr.	′	″		○	gr.	′	″	
142	102	32	41	0. 407380	204	113	37	25	0. 523406
144	103	00	31	0. 411784	208	114	9	52	0. 529705
146	103	27	47	0. 416132	212	114	41	23	0. 535886
148	103	54	31	0 420430	216	115	12	02	0. 541958
150	104	20	43	0. 424676	220	115	41	51	0. 547922
152	104	46	22	0 428866	224	116	10	52	0. 553782
154	105	11	33	0. 433012	228	116	39	7	0. 559538
156	105	36	16	0 437110	232	117	6	38	0. 565199
158	106	00	32	0. 441164	236	117	33	27	0. 570762
160	106	24	23	0 445178	240	117	59	35	0. 576233
162	106	47	47	0. 449144	244	118	25	5	0. 581616
164	107	10	44	0 453060	248	118	49	57	0. 586912
166	107	33	17	0 456936	252	119	14	14	0. 592122
168	107	55	27	0 460772	256	119	37	56	0. 597252
170	108	17	14	0 464208	260	120	1	6	0. 602301
172	108	38	37	0. 468318	264	120	23	44	0. 607274
174	108	59	39	0 472030	268	120	45	52	0. 612174
176	109	20	20	0 475705	272	121	7	30	0. 616998
178	109	40	40	0 479340	276	121	28	39	0. 621750
180	110	00	40	0. 482937	280	121	49	22	0. 626438
182	110	20	20	0. 486498	284	122	9	38	0. 631056
184	110	39	41	0. 490022	288	122	29	28	0. 635608
186	110	58	44	0. 493512	292	122	48	54	0. 640098
188	111	17	28	0. 496965	296	123	7	57	0. 644525
190	111	35	55	0. 500384	300	123	26	36	0. 648893
192	111	54	05	0. 503769	310	124	11	40	0. 659559
194	112	11	58	0. 507121	320	124	54	36	0. 669880
196	112	29	34	0. 510441	330	125	35	34	0. 679876
198	112	46	55	0. 513729	340	126	14	44	0. 689568
200	113	4	00	0. 516984	350	126	52	12	0. 698970

A general Table to compute the Motion of Comets in a parabolic Orbit.

mean Mot.	Angle from Perihel.			Log. diff. from the Sun.	mean Mot.	Angle from Perihel.			Log. diff. from the Sun.
°	gr.	′	″		°	gr.	′	″	
360	127	28	6	0.708104	820	141	49	24	0.970836
370	128	2	33	0.716976	840	142	10	00	0.978397
380	128	35	38	0.725606	860	142	29	56	0.985771
390	129	7	27	0.734006	880	142	49	10	0.992970
400	129	38	4	0.742186	900	143	7	48	1.000000
410	130	7	34	0.750160	920	143	25	51	1.006871
420	130	36	2	0.757930	940	143	43	21	1 013586
430	131	3	30	0.765516	960	144	00	18	1.020155
440	131	30	2	0.772918	980	144	16	46	1.026583
450	131	55	41	0.780148	1000	144	32	46	1.032870
460	132	20	30	0.787216	1500	149	26	8	1.158188
470	132	44	32	0.794122	2000	152	26	15	1.246058
480	133	7	50	0.800882	2500	154	32	20	1.313703
490	133	30	25	0.807494	30 0	156	7	27	1.368678
500	133	52	20	0.813969	3500	157	22	49	1.414974
520	134	34	18	0.826522	4000	158	24	36	1,454950
540	135	14	0	0.838600	4500	159	16	36	1.490125
560	135	51	28	0.850187	5000	160	1	12	1.521521
580	136	27	6	0.861369	5500	160	40	5	1.549874
600	137	00	57	0.872155	6000	161	14	24	1.575718
620	137	33	13	0.882575	6500	161	45	00	1.599400
640	138	3	58	0.892649	7000	162	12	34	1.621417
660	138	33	21	0.902401	7500	162	37	34	1.641838
680	139	1	29	0.911866	8000	163	00	23	1.660922
700	159	28	23	0.921012	8500	163	21	20	1.678834
720	139	54	16	0.929907	9000	163	40	42	1.695708
740	140	19	5	0.938549	9500	163	58	38	1.711662
760	140	42	56	0.946951	10000	164	15	20	1.726784
780	141	05	55	0.955124	50000	170	52	0	2.197960
800	141	28	3	0.963082	100000	172	45	44	2.399655

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The Conſtruction and Uſe of the general Table.

As the planets revolve in elliptic orbits round the ſun, placed in their common *Focus*, ſo likewiſe do comets in parabolic ones; in ſuch a manner, as that equal areas are deſcribed in equal times; ſeeing then all parabola's are ſimilar, if any determinate part of the area of a given parabola be divided into any number of parts, a like diviſion will be made in all parabola's under the ſame angles, and the diſtances will be proportional; therefore Mr. *Halley*'s table will ſerve for all comets; the manner of the calculation of which is as follows: Let S in Plate XII. Fig. 10. repreſent the ſun; POC the orbit of the comet; P the *Perihelion*; O the place of the comet, being a quadrant diſtant from the *Perihelion*; C any other place; join CP, CS; let ST and SR be equal to CS; and drawing the right lines CR, CT (of which CT is a tangent to the curve, and CR a perpendicular) let fall the perpendicular CQ upon the axis PSR: Now having any area, as COPS given, to find the angle CSP and the diſtance CS; becauſe, from the nature of a parabola, the right line RQ is always equal to half the *Latus rectum*; let the *Latus rectum* be put $= 2$, then QR will be $= 1$; let the right line CQ be $= z$; therefore, PQ will be $= \frac{1}{2} zz$, and the parabolic ſegment COP will be $= \frac{1}{12} z^3$; but the triangle CSP will be $= \frac{1}{4} z$; conſequently the mixtilinear area COPS will be $= \frac{1}{12} z^3 + \frac{1}{4} z = a$, and $z^3 + 3z = 12a$; wherefore reſolving this cubic equation, z or the ordinate CQ will be known; now let the area OPS be divided into 100 parts, this area is the 12th part of the ſquare of the *Latus rectum*, conſequently, $12a$ = that ſquare $= 4$; if therefore the roots of the equations $z^3 + 3z = 0,04 : 0,12 : 0,16$, *&c.* be ſucceſſively extracted, there will be found ſo many z, or ordinates CQ reſpectively; and the area SOP will be divided into 100 parts; and in the ſame manner the calculation may be continued beyond the place O; for the root of this equation, when RQ is $= 1$, is the tabular tangent of the angle CRQ, or of half the angle CSP, and conſequently the angle CSP is given; and RC the ſecant of the ſame angle CRQ, is a mean proportional between RQ or 1, and RT, which is double SC, as is very well known from conics; if SP be put $= 1$, the *Latus rectum* will be 4 (as in Mr. *Halley*'s table) and RT will be the diſtance ſought, towit, the double of SC in the former parabola; and after this manner Mr. *Halley* calculated the above table, ſerving to repreſent the motions of all comets; for none of them that have hitherto been obſerved, have deviated from the laws of the parabola.

Now

Now it remains to give the rules of the calculation, and to ſhew the method of computing the apparent place of a comet by theſe numbers; the velocity of a comet moving in a parabola, is always to the velocity of a planet revolving in a circle round the ſun, at the ſame diſtance from the ſun, as $\sqrt{2}$ to 1, as is plain from Sir *Iſaac Newton's Princip. Philoſ. Natur. Mathem. Lib.* I. *Prop.* 16. *Corol.* 7. if therefore, a comet in its *Perihelium* be ſuppos'd to be at a diſtance equal to that of the earth from the ſun, the diurnal area, which the comet would deſcribe, will be to the area, which the earth deſcribes, as $\sqrt{2}$ to 1; and conſequently, the annual period would be to the time, wherein ſuch a comet would deſcribe a quadrant of its orbit from the *Perihelium*, as 3,14159, *&c.* (that is, as the area of the circle) to $\sqrt{8}$; therefore the comet would deſcribe that quadrant in 109 d. 14 h. 46′; and conſequently that parabolic area, analogous to the area POS, being divided into 100 parts, the parts correſponding to each day are 0,912280, whoſe logarithm 9,960128 is to be reſerved for conſtant uſe; but the times, in which a comet would deſcribe ſimilar quadrants in a greater or leſs diſtance, are as the revolutions in circles; that is, in the ſeſquiplicate ratio of the diſtances; and conſequently, the diurnal area's eſtimated in centeſimal parts of a quadrant (which are put as the meaſures of the mean motion, like degrees) are in each in a ſubſeſquialteral ratio of the diſtance of the *Perihelium* from the ſun.

Theſe neceſſary things being premiſed, let it be propoſed to compute the apparent place of any of our comets for any given time. 1. Let the ſun's diſtance from the equinox, and the logarithm of its diſtance from the earth be known. 2. Let the interval of time, between the time of the *Perihelium* and the time given, be taken in days and decimal parts of a day; add to the logarithm of this number the conſtant logarithm 9,960128, and the arithmetical complement of the ſeſquialteral logarithm of the diſtance of the *Perihelium* from the ſun; the ſum will be the logarithm of the mean motion, which is to be ſought for in the firſt column of the general table. 3. Let the angle from the *Perihelium*, correſponding with the mean motion be taken, as alſo the logarithm for the diſtance from the ſun; and if the time be after the *Perihelium*, in direct comets, you muſt add, and in retrograde ones ſubſtract; but if the time is before the *Perihelium*, in direct comets ſubſtract, and in retrograde comets, add the angle ſo found to, or from the place of the *Perihelium*; and thus you have the place of the comet in its orbit; and to the

of

logarithm of the diſtance found in the table adding the logarithm of the diſtance of the *Perihelium*, the ſum is the logarithm of the true diſtance of the comet from the ſun. 4. Having the place of the node, together with that of the comet in its orbit, let the diſtance of the comet from the node be taken; and having the inclination of the plane, there ſhall alſo be given, from the known rules of trigonometry, the place of the comet reduced to the ecliptic, together with its inclination, or heliocentric latitude, and the logarithm of its curtate diſtance. 5. From theſe *Data*, by the very ſame rules, by which the places of the planets are found, from the given place and diſtance of the ſun, we ſhall alſo find the apparent, or geocentric place, together with the apparent latitude; which is worth while to illuſtrate by an example or two.

Example I. *To find the place of the Comet of the year* 1664 March 1 d. 7 h. 00′ *P. M. at* London; *that is* 96 d. 19 h. 8′ *after its* Perihelium, *which happened in* November 24° 11 h. 52′

Log. diſt. Peribel.	10.011044	Perihel. ☊	10	41	25
Log. ſeſquialt.	10.016566	Correſp. Ang.	83	38	05
Comp. Arith.	9.983434	Comet in orb ♂	17	3	20
	9.960128	☊ ♊	21	14	00
Log. time	1.985862	Comet from node	34	10	40
Log. mean Mot.	1.929424	Red. to Eclipt.	32	19	05
Mean Motion	85.001	Comet helioc. ♂	18	54	55
		North. Inclin.	11	46	50

Log. for diſt.	0.255396			
Log. Perihel.	0.011044			
Co-ſine Inclin.	9.990754			
Log. diſt. curt.	0.257167			
Log. of Sun's diſt.	9.997918			
	☉ ♐	21	44	45
Appar. place of Comet	♈	29	18	30
Appar. Lat. N.		8	36	15

Example II. *To find the place of the Comet* Anno 1683, July 23° 13 h. 35′ *P. M.* at London, *or* 13 h. 40′ *equated time, that is*, 21 d. 10 h. 50′ *after the* Perihelium.

Log.

Log. dist. Perihel.	9.748343	Perihel. ♊	25	29	30
Log. sesquialt.	9.622514	Corresp. Ang.	56	47	20
Compl. Arith.	0.377486	Comet in orb ♈	28	42	10
	9.960128	♉ ♓	23	23	00
Log. of time	1.310723	Com. from ♉	35	19	10
Log. mean Mot.	1.648337	Red. to Eclipt.	4	48	30
Mean motion	44. 498	Comet helioc. ♓	28	11	30
		North. Inclin.	35	2	00

Log. for dist.	0.111336
Log. Perihel.	9.748343
Cosine Incl.	9.913187
Log. dist. curt.	9.772866
Log. ☉'s dist.	0.006104
☉'s place ♌	10 41 25
Appar. place of Comet ♋	5 11 50
North Lat.	28 52 00

At the instant specified in the first example, it was observed by Dr. *Hook* at *London*, that the comet applied to the second star of *Aries*; so that it was found to be nine minutes more northerly, and three minutes more easterly than the said star: In the second example, Mr. *Halley* himself near *London*, found (with the same instruments wherewith he had formerly observed the stars of the southern hemisphere) the place of the comet at 5° 11′ ½ of ♋ with 28° 52′ N. Lat. the observation made at *Greenwich* almost at the same moment of time exactly agreeing therewith.

But the comet *Anno* 1680, which almost touched the sun (for in its *Perihelium* it was not the ⅓ part of the diameter of the sun distant from its superficies) having its *Latus rectum* exceeding small, it could not by reason of the great velocity of the mean motion not be brought into the generel table; therefore, in this comet it is the better way, after having found the mean motion, by the help of the preceeding equation $z^3 + 3z = \frac{4}{100}$, of the mean motion, to find from the same the tangent of ½ the angle from the *Perihelium*, together with the logarithm for the distance from the sun; which being given, you are to proceed by the very same rules as in the rest: It is to be observed, that the five first comets; the third and fourth of which was seen by *Petrus Apianus*, and the fifth by *Paulus Fabricus*, as was the tenth

tenth by *Mæſtlinus* in the year 1596, have not the ſame degree of certainty with the reſt; the obſervations not having been made with the proper inſtruments or the neceſſary exactneſs; and therefore, diſagreeing with each other, they can by no means be reconciled with a regular calculation; *Blanchini* alone obſerved at *Rome* the comet *Anno* 1684; and the aſtronomers at *Paris* the laſt comet in 1698, whoſe path they have deſcribed in an unuſual manner; this very obſcure comet tho' ſwift and pretty near the earth, eſcaped our obſervations: Mr. *Halley* forbore to inſert into his catalogue the two remarkable comets that appeared, the one in *November* 1689, and the other in *February* 1702, for want of obſervations; for directing their courſe towards the ſouthern parts of the world, and being ſcarcely viſible in *Europe*, they were not obſerved by perſons equal to the taſk: It is to be obſerved, that 11 of the comets in Mr. *Halley*'s catalogue moved direct, *i. e.* according to the order of the ſigns; *viz.* thoſe in the years 1532, 1556, 1580, 1585, 1618, 1652, 1661, 1672, 1680, 1584 and 1686; and that the other 13 were retrograde, *i. e.* moved contrary to the order of the ſigns.

Upon thoroughly weighing all theſe things, and comparing the reſt of the elements of the motions of theſe comets with each other, it will appear, that their orbits are diſpoſed in no certain order; and that they are not confined like the planets to the zodiac, but that they move indifferently, every way both retrograde and direct; whence it is plain, that they are not moved by *Vortices*; the diſtances of their *Perihelia* are found to be ſometimes greater and ſometimes leſs; whence we have reaſon to ſuſpect, that there are a great many more comets, which being at remote diſtances from the ſun, and being obſcure and without a tail, may for that reaſon eſcape our obſervation.

We have hitherto conſidered the orbits of comets as perfectly parabolic, from which ſuppoſition it would follow, that comets, being impelled by a centripetal force towards the ſun, do deſcend from infinite diſtances, and by their fall acquire ſo great a velocity, as to convey them into the remoteſt ſpaces of the ſyſtem, and by a perpetual *Niſus* tending upwards, never afterwards to return again to the ſun; ſeeing then that the appearing of comets is very frequent, and that none of them is found to move in an hyperbola, or with a greater velocity than it would acquire in falling towards the ſun, it is more credible, that they revolve about the ſun in very excentric orbits, and return after very long periods; for, thus their number is definite and perhaps not ſo very great; and the ſpaces between the ſun and the fixed ſtars

Log. diſt. Perihel.	9.748343	Perihel. ♊	25	29	30
Log. ſeſquialt.	9.622514	Correſp. Ang.	56	47	20
Compl. Arith.	0.377486	Comet in orb ♈	28	42	10
	9.960128	♉ ♓	23	23	00
Log. of time	1.310723	Com. from ♉	35	19	10
Log. mean Mot.	1.648337	Red. to Eclipt.	4	48	30
Mean motion	44. 498	Comet helioc. ♓	28	11	30
		North. Inclin.	35	2	00

Log. for diſt.	0.111336	
Log. Perihel.	9.748343	
Coſine Incl.	9.913187	
Log. diſt. curt.	9.772866	
Log. ☉'s diſt.	0.006104	
☉'s place ♌	10 41 25	
Appar. place of Comet ♋	5 11 50	
North Lat.	28 52 00	

At the inſtant ſpecified in the firſt example, it was obſerved by Dr. *Hook* at *London*, that the comet applied to the ſecond ſtar of *Aries*; ſo that it was found to be nine minutes more northerly, and three minutes more eaſterly than the ſaid ſtar: In the ſecond example, Mr. *Halley* himſelf near *London*, found (with the ſame inſtruments wherewith he had formerly obſerved the ſtars of the ſouthern hemiſphere) the place of the comet at 5° 11′ ½ of ♋ with 28° 52′ N. Lat. the obſervation made at *Greenwich* almoſt at the ſame moment of time exactly agreeing therewith.

But the comet *Anno* 1680, which almoſt touched the ſun (for in its *Perihelium* it was not the ½ part of the diameter of the ſun diſtant from its ſuperficies) having its *Latus rectum* exceeding ſmall, it could not by reaſon of the great velocity of the mean motion not be brought into the generel table; therefore, in this comet it is the better way, after having found the mean motion, by the help of the preceeding equation $z^3 + 3z = {}_{100}^{4}$, of the mean motion, to find from the ſame the tangent of ½ the angle from the *Perihelium*, together with the logarithm for the diſtance from the ſun; which being given, you are to proceed by the very ſame rules as in the reſt: It is to be obſerved, that the five firſt comets; the third and fourth of which was ſeen by *Petrus Apianus*, and the fifth by *Paulus Fabricus*, as was the tenth

tenth by *Mæſtlinus* in the year 1596, have not the ſame degree of certainty with the reſt; the obſervations not having been made with the proper inſtruments or the neceſſary exactneſs; and therefore, diſagreeing with each other, they can by no means be reconciled with a regular calculation; *Blanchini* alone obſerved at *Rome* the comet *Anno* 1684; and the aſtronomers at *Paris* the laſt comet in 1698, whoſe path they have deſcribed in an unuſual manner; this very obſcure comet tho' ſwift and pretty near the earth, eſcaped our obſervations: Mr. *Halley* forbore to inſert into his catalogue the two remarkable comets that appeared, the one in *November* 1689, and the other in *February* 1702, for want of obſervations; for directing their courſe towards the ſouthern parts of the world, and being ſcarcely viſible in *Europe*, they were not obſerved by perſons equal to the taſk: It is to be obſerved, that 11 of the comets in Mr. *Halley*'s catalogue moved direct, *i. e.* according to the order of the ſigns; *viz.* thoſe in the years 1532, 1556, 1580, 1585, 1618, 1652, 1661, 1672, 1680, 1584 and 1686; and that the other 13 were retrograde, *i. e.* moved contrary to the order of the ſigns.

Upon thoroughly weighing all theſe things, and comparing the reſt of the elements of the motions of theſe comets with each other, it will appear, that their orbits are diſpoſed in no certain order; and that they are not confined like the planets to the zodiac, but that they move indifferently, every way both retrograde and direct; whence it is plain, that they are not moved by *Vortices*; the diſtances of their *Perihelia* are found to be ſometimes greater and ſometimes leſs; whence we have reaſon to ſuſpect, that there are a great many more comets, which being at remote diſtances from the ſun, and being obſcure and without a tail, may for that reaſon eſcape our obſervation.

We have hitherto conſidered the orbits of comets as perfectly parabolic, from which ſuppoſition it would follow, that comets, being impelled by a centripetal force towards the ſun, do deſcend from infinite diſtances, and by their fall acquire ſo great a velocity, as to convey them into the remoteſt ſpaces of the ſyſtem, and by a perpetual *Niſus* tending upwards, never afterwards to return again to the ſun; ſeeing then that the appearing of comets is very frequent, and that none of them is found to move in an hyperbola, or with a greater velocity than it would acquire in falling towards the ſun, it is more credible, that they revolve about the ſun in very excentric orbits, and return after very long periods; for, thus their number is definite and perhaps not to very great; and the ſpaces between the ſun and the fixed ſtars

are ſo immenſe, that there is room enough for a comet to perform its period, however large it may be; for the *Latus rectum* of an ellipſis is to the *Latus rectum* of a parabola, having the ſame *Perihelian* diſtance, as the *Aphelian* diſtance in the ellipſis is to its whole axis; but the velocities are in the ſubduplicate ratio of the ſame; wherefore, in very excentric orbits, this ratio approaches nearly to a ratio of equality, and the ſmall difference, which ariſes on account of the greater velocity in a parabola, is very eaſily compenſated in determining the ſituation of the orbit; therefore, the principal uſe of the elements of the motions in this table is, that whenever a new comet appears, we may by comparing the elements, know whether it is one of thoſe that formerly appeared; and conſequently, we may determine its period, and the axis of its orbit, and foretel its return; and Mr. *Halley* tells us that he had ſeveral reaſons to induce him to believe, that the comet in 1531, which was obſerved by *Apian*, was the ſame with that deſcribed in 1607 by *Kepler* and *Longomontanus*, and which he himſelf had ſeen and obſerved upon its return again in 1682; all the elements agree, and there is no other difference than the inequality of their periods; which yet is not ſo conſiderable, as that it may not be aſcribed to phyſical cauſes; for *Saturn*'s motion is diſturbed in ſuch a manner by the other planets, eſpecially *Jupiter*, that its periodical time is for ſome whole days uncertain; how much more may a comet be ſubject to ſuch irregularities, whoſe orbit riſes almoſt four times higher than *Saturn*'s, and whoſe velocity, tho' never ſo little augmented, may change its orbit from an ellipſis to a parabola; that it was the ſame comet, is farther confirmed, from that obſerved in the ſummer of 1456, to paſs retrograde, almoſt in the ſame manner, between the ſun and the earth; which tho' it was not obſerved aſtronomically by any, yet Mr. *Halley* conjectures, that it was the ſame with the former, from its period and the manner of its tranſit; whence he ventures to foretel its return in 1758, and if this happens, there will be no further cauſe to doubt, but that the reſt may likewiſe return; aſtronomers will therefore have a large field, to exerciſe themſelves in for ſeveral ages, before they can determine the number of ſo many and ſo great bodies that revolve round the common center of the ſun, and reduce their motions to certain rules: Mr. *Halley* was apt to believe, that the comet of 1532 was the ſame with that obſerved by *Hevelius* in the beginning of 1661; but *Apian*'s obſervations, which are the only ones we have, are too inaccurate, to determine any thing certain from them in ſo nice an affair: Sir *Iſaac Newton* delivers a me-

a method of conſtructing the orbits of comets by three accurate obſervations, *Philoſ. Natural. Princip. Mathemat. lib.* III. which afterwards Dr. *Gregory* fully and clearly illuſtrated in the fifth book of his phyſical and geometrical aſtronomy.

Here one thing is to be obſerved, *viz.* that ſome of theſe comets have their nodes ſo near the annual orbit of the earth, that ſhould it happen at the time of the return of a comet, that the earth was near its node, whilſt the comet paſſes with an incredible velocity, it would alſo have a very ſenſible parallax, and which would be to the ſun's parallax in a given ratio; whence, upon ſuch like tranſits, there will be a very favourable opportunity (which yet ſeldom happens) of determining the diſtance of the ſun from the earth; which hitherto could be concluded but very looſely, and that only by means of the parallax of *Mars* in oppoſition to the ſun, or that of *Venus* in her *Perigæum*; and tho' indeed it is thrice greater than the parallax of the ſun, yet it is ſcarcely perceptible with any inſtrument; and this uſe of comets was ſuggeſted by the famous geometrician *Nic. Facio*; for the comet of the year 1472 had a parallax 20 times greater than that of the ſun; and had the comet *Anno* 1618 arrived, about the middle of *March*, at its deſcending node, or had the comet *Anno* 1684 come a little ſooner to its aſcending node, being very near the earth they would have had ſtill more ſenſible parallaxes; of all the comets there was none that approached nearer the earth than that *Anno* 1680; for, upon a calculation, it was no further diſtant towards the north from our annual orbit, than the ſun's ſemidiameter (or the radius of the moon's orbit, as Mr. *Halley* ſuppoſes) and that too in *November* 10th 1 h. 6′ *P. M*; at which time had it been in conjunction with the earth as to longitude, there might have been obſerved in its motion a parallax equal to that of the moon: Mr. *Halley* leaves it to philoſophers to diſcuſs, what conſequences would ariſe from the appulſe, contact, or colliſion of the celeſtial bodies, which yet is not altogether impoſſible.

The Bark *of* Trees; *by M.* Leewenhoeck. Phil. Tranſ. N° 297. p. 1898.

M. *Leewenhoeck* had for ſeveral years been convinced, as to his own particular, that the bark of trees is produced from the wood, and not the wood from the bark, as ſeveral have affirmed; for farther ſatisfaction about this matter, he had a piece of cinnamon-wood, about the bigneſs of a writing quill, which had its bark ſtill on; he judged that this piece of cinna-

mon-wood would be the moſt proper to prove, that the bark is formed out of the wood, becauſe, the horizontal veſſels of that wood were of the ſame colour with the cinnamon itſelf; but how nicely ſoever he managed this wood, he could not cut it a-croſs into pieces, ſo as to keep the bark and wood united, but the bark would always be ſeparated from the wood; which he aſcribes to the iſland of *Ceylon*, where this wood grows, being ſituated between the fifth and tenth degrees of northern latitude; ſo that the fruit, wood, and bark are of one year's growth, by which means new ſap, and juices are always carried up between the wood and the bark, in order to form new ones; which is the reaſon, that the bark of cinnamon is ſo eaſily ſeparated from the wood; wherefore, not finding his account in this experiment, M. *Leewenhoeck* cut off a ſmall twig of a cherry-tree, which is repreſented by A B C D E Plate XII. Fig. 11. in the wood of which, the canals or veſſels of the bark, by which the ſame is nouriſhed, are not extended lengthwiſe, but circularly about the wood; for which reaſon, the bark of the ſaid wood cannot be ſtripped off lengthwiſe, but circularly, contrary to ſome other wood, as in the aforeſaid figure, where a ſmall piece of the bark as ſtripped off, is repreſented by C F D G; in which is to be obſerved, that the canals or veſſels, whereof it conſiſts, run from C to F, or from D to G: M. *Leewenhoeck* aſſerted formerly, that in all countries where there is any winter, ſo far as to put a ſtop to the growth of trees, as long as the growth continues, the bark grows thicker, and the new bark protrudes that which was formed before, further and further from the wood; inſomuch, that in the bark of old trees, one may cut a finger's breadth in depth, before he can come at any thing like greenneſs, or ſap; and by carefully conſidering that bark, one may diſcover what part thereof is from time to time deprived of its nouriſhment, and conſequently, what part of it is quite dead: By theſe his laſt obſervations, M. *Leewenhoeck* diſcovered in a twig of a cherry-tree of a year's growth, that the bark conſiſts at leaſt of ſix thin membranes, whoſe exceeding thin veſſels or fibres extended themſelves circularly round the wood, and thoſe membranes were very cloſely united to each other.

Fig. 12. H I K L repreſents one of theſe membranes, placed before the microſcope, after having been ſo ſeparated, as nicely as poſſible, from the reſt; where may be obſerved, that the veſſels or canals do not run lengthwiſe, but circularly round the wood; for which reaſon, the ſaid veſſels cannot long remain entire, but muſt from time to time be broken in pieces; when he

cut

cut a-croſs the wood of a cherry-tree, which was about a year old, in order to ſhew the horizontal veſſels derived from the wood to the bark, and by which the bark receives its growth and nouriſhment, the bark, by reaſon of the ſoftneſs and flexibility of thoſe parts that lay next the wood, did always yield ſo much, that it was impoſſible to delineate the ſaid veſſels: Upon this M. *Leewenhoeck* was led to conſider beech-wood, becauſe, the greateſt part of that wood is covered with a red bark, which ſticks cloſe to the wood, and grows yearly thicker; and upon the outſide of that bark there is a whitiſh ſort of bark often produced in a year, which falls off from the wood, as if is was peeled; but this only happens in beech-wood of an ordinary thickneſs; whereas, in the thickeſt wood this peeling or ſcaly ſort of bark is not produced, whereby the bark grows exceeding thick, and the moſt part of it remains, as it were, without nouriſhment.

Fig. 13. MNOPQR, repreſents a ſmall particle of the laſt mentioned wood, cut a-croſs, after having been ſteeped in water, wherein are plainly to be ſeen the aſcending veſſels or canals, both great and ſmall, between which run the horizontal veſſels, which receive their juices from the aſcending ones; after ſeveral cuts made with a ſharp knife, he found the bark of the wood to be exceeding hard, which was moſtly occaſioned, as he imagined, by a coagulated whitiſh matter, which a perſon would take for roſin; the hardneſs of which hindered him from cutting the wood and bark ſo eaſily together, as not to hurt the horizontal veſſels, which were continued from the wood to the bark in a right line; QUTSR repreſents, as it appeared before a microſcope, a particle of the above mentioned bark, in which the horizontal veſſels, as they lie in the wood, and are continued on to the bark, and from whence the bark is produced, are ſhewn by NMOP, whereof N and O do not go quite through the bark, by reaſon of the hard ſubſtance before-mentioned, and which is to be ſeen in X; but the horizontal veſſels, repreſented by MRS and PQUT, go throughout the wood, ſo far into the bark, as to preſerve it from any mortification: Now, as the bark of the beech-tree, or rather its veſſels or canals, run circularly round the wood, M. *Leewenhoeck* could not at firſt conceive, how thoſe canals could be produced out of the horizontal veſſels; but at laſt he diſcovered, that as the horizontal veſſels are continued from the wood, and carried on into part of the bark, repreſented by QUT, and ſhew between Q and U a few of thoſe veſſels which ariſe out of the ſaid horizontal ones, and run circularly about the bark; and how nicely ſoever he obſerved them, he could

could not diſcover one aſcending canal; which muſt needs run lengthwiſe up the bark, in caſe the ſaid bark had its riſe from the root of the tree.

Fig. 14. A B C D. alſo repreſents a thin ſcaly particle of the bark of the ſaid wood, as it appeared before the microſcope, the veſſels or canals of which likewiſe run horizontally from A to B, or from C to D; here obſerve, that this and the preceeding ſmall particles of bark, are not ſo open as they are repreſented, but that only the veſſels which run circularly about the wood are delineated, which at firſt lay cloſe to each other, but as the wood grew larger, they were more and more ſeparated from each other.

Fig. 15. W X Y Z. alſo ſhews a little ſcale of the bark of the twig of a tree, wherein the veſſels repreſented by W X or Z Y, run circularly round the wood.

M. *Leewenhoeck* had by him a piece of cinnamon-bark, brought from *Candy*, in the iſland of *Ceylon*, which was near eight inches long; a ſmall part of which is repreſented by E F G H. Fig. 16. M. *Leewenhoeck* judged by the diviſions, which he obſerved between I and G, and which was the thickneſs of the bark, that the cinnamon-tree to which it belonged, was near 12 years old; and that the tree was about 6 inches diameter; he examin'd ſeveral times the outſide of this bark, and always found that it was ſo brittle, as if it were partly corrupted, and upon cracking thoſe brittle particles between his teeth, he could perceive no taſte of cinnamon therein, ſo that he was obliged to pare away ſ parts of the outſide of the bark, before he could come to the ſtrong and true taſte of the cinnamon: Having moreover, enquir'd into that part of the bark that lies neareſt, and joined as it were to the wood, and cutting it to pieces, he was further ſatisfied, that the cinnamon, otherwiſe called the bark, receives both its nouriſhment and increaſe from the wood only, and not from the root; for upon dividing this bark into ſmall parts, he could diſcover no aſcending veſſels therein; but *é contra*, ſo many horizontal veſſels proceeding from the wood, and thoſe likewiſe ſo large, that he never diſcovered ſo many in the bark of any other trees.

Fig. 17. L M N O P Q R S. repreſents a very ſmall particle of cinnamon-bark, wherein the horizontal veſſels lie by each other in ſuch order, as is ſhewn berween L M N R S, or between N O Q R, in which they are all cut a-croſs; ſeveral of theſe horizontal veſſels are filled with a reddiſh matter, which in ſome veſſels is not ſo high coloured as in others, ſome of them being almoſt yellow; theſe horizontal veſſels are repreſented as they appeared, hexangu-

lar as it were, which is the moſt perfect figure nature could beſtow on them, in order to prevent any interſtices or vacuities between them: We may alſo ſee, that about the ſaid horizontal veſſels, there lie together longiſh particles (repreſented by LMN, and ſome of them are larger than others) that run into a point at both extremities; and the ſaid parts do alſo ſurround the horizontal veſſels; moreover, theſe particles often contain in them a matter of different colours, which are entirely ſeparated from each other, and appears as in NRS, and where no colours are to be perceived in the ſaid figures, there they are tranſparent: M. *Leewenhoeck* ſuppoſes, that theſe long tranſparent parts, as alſo thoſe that are coloured, together with the horizontal veſſels, which are almoſt all of them filled with a coloured matter, are the ſole ingredients of the above-mentioned bark, or cinnamon; OPQ in the ſaid figure repreſents but a part of the horizontal veſſels, that lie by each other: All the ſaid long particles, which in a great meaſure compoſe the cinnamon-bark, are not incurvated as in the laſt figure; but a great many of them are extended in right-lines, as in ABCDEFG. Fig. 18. which repreſents a very ſmall particle of the above-mentioned long parts, and which likewiſe incloſes ſome horizontal veſſels; and wherein you may ſee at A how regularly the ſharp points are ranged by each other; as alſo between BF and CE, between which the horizontal veſſels are to be ſeen in that order, wherein they always lie; that ſharp and pointed particle repreſented by FH, ſeems to be out of its place; and he ſuppoſes, that in dividing it from the other parts, he might have broke it off at F; he alſo placed three other long ſharp pointed particles, before his microſcope, as in IKLM. Fig. 19. in which alſo may be ſeen, in how regular an order they appear, as at KM; from whence we may conclude, that all the other parts of the like nature, are diſpoſed in the ſame manner.

Fig. 20. NOP repreſents another pointed particle, exceedingly incurvated, which he ſuppoſes, might be occaſioned by its having ſurrounded two ſeveral diviſions of the horizontal veſſels: We can pretty eaſily conceive, how one canal is produced or iſſues out from another, but how the ſaid long ſharp pointed particles, repreſented by Fig. 17. 18. 19. 20. are produced, as well as a great many other phænomena, he cannot account for: Moreover, M. *Leewenhoeck* examined into the nature of the bark of a thick lime-tree, and the rather becauſe, he knows no other bark, whoſe parts are ſo eaſily ſeparated from each other, either in length or breadth; inſomuch, that in *Muſcovy* they make mats for packing and rope-work

work thereof, which is very ſtrong; and tho' it ſhould lie long wet, it is not eaſily ſubject to rot.

Fig. 21. A B C D E F G H I. repreſents a ſmall particle of the bark of a lime-tree, as it was cut a-croſs; where, by A B C are ſhewn the horizontal veſſels that ariſe from the wood, which conſequently are cut lengthwiſe; tho' theſe veſſels at their firſt iſſuing out of the wood lie cloſe to each other, as from A to B, and from B to C; yet they do not always continue ſo cloſe, but as the tree grows thicker and larger, the horizontal veſſels are ſeparated the more from each other; as for inſtance, that which at B is but one bundle or collection of veſſels, with the increaſe of the tree, it divides itſelf into two, and the ſeparation becomes larger and larger, as in B M K and B M L; now, that there may be no interſtice or vacuity between the ſaid horizontal veſſels, there are other veſſels that proceed from thoſe, as may be ſeen between M I D, which new veſſels yield a matter that fills the place of M L K; theſe parts are roundiſh, but ſo interlinked with each other, that they ſerve for canals; beſides, they are repreſented larger than they appeared to be: Theſe horizontal veſſels do not run thro' the whole thickneſs of the old bark; for in ſome places the bark dies ſooner than in others for want of nouriſhment; inſomuch, that you may perceive in the bark of a lime-tree of an ordinary thickneſs, three diſtinct cruſts lying on each other, the outermoſt of which being deſtitute of nouriſhment, by little and little it becomes dry and withers: M. *Leewenhoeck* cannot think that the great number of deſcending veſſels diſcovered in the bark of the lime-tree, can proceed from the root of the ſaid tree, but depend on the horizontal veſſels of the ſame, which, by reaſon of their exceeding ſmallneſs are hardly viſible in the laſt figure; for if the nouriſhment of the bark proceeds from the roots, the bark would never decay, unleſs the tree did ſo likewiſe; whereas, we ſee, that in ſome trees the greateſt part of the bark is dead or withered.

Fig. 22. N O P Q R S repreſents a very ſmall particle of the bark of a lime-tree, as it appeared before a larger microſcope; wherein are ſhewn ſome of the orifices of the canals, that lie lengthwiſe in the bark, and are here cut a-croſs, chiefly to give a view of the horizontal canals, as they are cut lengthwiſe, at N S or P Q, which are repreſented in Fig. 21. by A I H, B L M G, B M K F and C D E; theſe canals ſhewn by N S or P Q are not of a continued hollowneſs throughout, but rather ſeem to conſiſt of oval particles linked to each other; ſo that he was apt

to

to think that each of the aforeſaid oval particles were provided with a valve, which valves make them appear like ſo many oval figures; the uſe of which valves might be to hinder the juice or ſap, which is raiſed up into thoſe parts by the heat of the ſun, from falling down or deſcending after ſun ſet; eſpecially, if we conſider, that there muſt be cauſed ſo ſtrong a protruſion by the ſaid canals in ſpring-time, as not only to ſeparate the bark from the wood, but alſo to burſt the outermoſt parts of the bark, that are already hard, dry and withered: M. *Leewenhoeck* ſaid before, that the horizontal veſſels or canals in cinnamon are hexangular, which is the moſt perfect figure, and takes up the leaſt room; from whence he alſo concludes, that the horizontal veſſels in Fig. 22. are hexangular, tho' he did not ſee them lie in the ſame order; for when he examined into the horizontal veſſels or canals of the cinnamon, he found, that they were of the ſame configuration, as in N S, and P Q, Fig. 22. *viz.* that they conſiſted of oval figures.

Fig. 23. A B C D E F G repreſents, as it appeared before the microſcope, a little ſlice of the lime-tree wood cut off length-wiſe, in which may be reckoned in nine ſeveral places, the horizontal veſſels or canals that are cut acroſs, ſituated between the ſmall aſcending veſſels, that for the moſt part nouriſh the wood; and thoſe horizontal canals are alſo continued into the bark, ſo far as it is alive, and ſerve for its increaſe and nouriſhment: Now, there is no difference between the horizontal veſſels in the wood and in the bark, but in the aſcending veſſels and the bark there is a difference; for they are of a like diſpoſition with the horizontal veſſels in the wood and in the bark; and ſo they agree with thoſe as repreſented by N S or P Q in Fig. 22. Now, if we find, that the horizontal canals both in the wood and bark, are of a like contexture; and that the aſcending veſſels in the bark of a lime-tree are ſo likewiſe, we may hence more certainly conclude, that the bark is produced from the wood, and not from the root.

M. *Leewenhoeck* was again led to conſider cork, which is ſaid to grow as the bark of a tree, upon a certain ſort of oak in *Spain*; which if it be ſo, he ſuppoſes, that the burning which we perceive in the leaves is done by two hot iron plates, in order to make it flat and ſtreight; he then took one of thoſe pieces of cork which are cut into ſtoppers for bottles, as repreſented by A B C D E F. Fig. 24; here you muſt ſuppoſe, that B G is the part that lay next the tree, and that E was the outſide of the ſame; in the ſaid piece of cork, between G H I K E, he obſerv'd

five diſtinct diviſions, running a-croſs from F to D, the part that ſurrounded the tree; from whence he concludes, that the cork was arrived to ſuch a thickneſs in five years time, for each ſtreak or diviſion denotes the growth of that year; he alſo obſerved, four diſtinct dark ſtreaks, of which G I is the middlemoſt; he ſuppoſed they had been great canals, but he could not conceive for what end they were formed; only he concluded from thence, that in caſe theſe great canals had not been cut thro' in that manner lengthwiſe, the cork would not have been ſo thick; we muſt likewiſe conclude, that the length of all corks (in order to prevent either moiſture or air from paſſing thro' them) muſt correſpond to the length of the cork as it grows upon the tree; ſo that that part of the cork repreſented by A B C was the lowermoſt, and D E F G was the uppermoſt, or near the uppermoſt part, according to its ſituation upon the tree; now, for further ſatisfaction, he cut a little piece of cork, as from G to H, where you may ſuppoſe, that it was joined to the tree; and having placed the ſaid piece before a microſcope, he perceived, that all the canals were placed in the ſame manner as if they iſſued out from the wood, without diſcovering in the leaſt any aſcending veſſels, tho' he cut it never ſo often; from whence he again concludes, that the growth of the cork proceeded from the wood.

Fig. 25. L M N *ab* O P Q ſhews a ſmall particle of cork, as it was cut off between G and H, of which let us ſuppoſe L M N to be the part next the tree; and ſo the veſſels or canals, by which it receives its increaſe, run horizontally, as from L to Q, from M to P, and from N to O; but he could not find one ſingle canal that was perpendicular, or can be ſaid to proceed from the root; theſe before-mentioned canals have no paſſage thorough, and it ſeems to M. *Leewenhoeck*, that there are ſo many valves in each canal, as there are horizontal veſſels therein; by *ab* in the above Fig. is repreſented a line running quite a-croſs, and ſomewhat incurvated, which is that part of the cork, where the ſeaſon of the year being over, a ſtop was put to the growth thereof; for further ſatisfaction, he cut another piece of cork repreſented by R S T V. Fig. 26. as it appeared thro' a greater magnifier than that made uſe of in Fig. 25; this piece of cork was cut off from Fig. 24. between B and G, and was that part which was neareſt, or united to the tree, and from whence it received its increaſe; ſo that conſequently thoſe horizontal canals which in Fig. 25. were cut lengthwiſe, were here cut a-croſs; in Fig. 27. it may be perceived, that almoſt all thoſe parts that were cut a-croſs, did not conſiſt of round canals, but of hexangular

once,

ones, which is agreeable to the moſt perfect order, becauſe it prevents all intermediate vacuities; and M. *Leewenhoeck* ſuppoſes, that in caſe one could procure a piece of cork, before it had been made ſtreight and flat, after the aforeſaid manner, we ſhould ſee the canals cut a-croſs, as in Fig. 27. between R S T U more plainly than we now do; whereas, by the making it ſtrait, a great many canals are diſplaced and diſordered; as alſo by cutting it with a knife the exceeding fine membranes whereof the canals are compoſed, are often torn or broken to pieces.

Horn-like Excreſcencies *growing on the* Fingers, *&c. by Dr.* Richard Wroe. Phil. Tranſ. N° 297. p. 1899.

THERE lived at *Bolton*, eight miles from *Mancheſter*, one *Nathaniel Hulme*, aged about 17, who had the ſmall-pox about eight years of age; ſoon after which, he had a ſtubborn itch, almoſt to the degree of a leproſy, with which his fingers and thumb-nails began to grow thick, and by degrees to harden into horns; which grew in ſeven or eight months an inch long, ſome almoſt two inches, and others much longer; it began in the fore-finger of his left-hand, and ſo came to all the reſt of that hand, which had as many horns as fingers and thumb; all which horns in about a twelvemonth fell off by degrees; that which grew firſt falling off firſt, without any pain, unleſs when cut off, as they were at the beginning; there appearing large quicks, as they are called, or roots under the nails; by degrees they came on the thumb, and then on the fingers of the right-hand, which grew to the ſame length with the former, in about a year's time, and then fell off, he having ſhed them five or ſix ſeveral times; one of the horns that grew on the ring-finger of the left-hand, was a quarter long; after they had all come off his left-hand, they began to grow again; that on his little finger was two inches long; and the Dr. had one or two of them by him; about two years afterwards the Dr. ſaw him frequently, when the horns ſtill continued to grow and fall off as uſual; he had horns on every toe, but he kept them cut, that he might be able to wear ſhoes; and he was ſo overſpread with the leproſy, that the Dr. thought he could not live long.

Some Swediſh *Coins, and a* Calculation *for finding* Eaſter; *by Mr.* Ralph Thoresby. Phil. Tranſ. N° 297. p. 1901.

MR. *Thoresby* had a *Swediſh* coin, or rather ſquare copper-plate, nine inches broad, and nine and a half long, which was much like the Roman *Æs grave*, and was current *A.* 1679,

tho' now they are not to be met with; it had at each corner the impreſſion of a crown, under which is the year, and round it this inſcription CAROLUS XI. D.G. SVE. GOT. WAN. REX; and in the middle of the plate in a circle 2 DALER. SÖIH M̄*ijt*; the other ſide of the plate has no inſcription.

Richard Thornton Eſq. made the following calculation for finding *Eaſter*.

Rightly to underſtand the Rule in our Common Prayer Books for finding Eaſter.

Obſerve 1. That the 21ſt of *March* in all but leap-years, and in leap-years the 20th of *March*, was at the time of the council of *Nice*, when this rule was made, the vernal equinox; conſequently; 2. That the 20th of *March* in leap-years, is the ſame as the 21ſt of *March* in common years. 3. That the full moon meant in this rule is not to be found in our almanacks, but by the kalender of our common-prayer book; where in the firſt column, the golden number of every year is placed over againſt the day of the new moon, in every month of the year. 4. That the 14th day, including the 1ſt day of the moon, is the full moon, and not the 15th, as Dr. *Wallis* would have it in *Phil. Tranſ.* N° 240.

An Experiment on the Propagation of Sound *in condenſed* Air; *together with a Repetition of the ſame in an open Field; and of the Diminution of* Sound *in rarified* Air; *by Mr.* Francis Hauksbee. Phil. Tranſ. N° 297. p. 1902.

UPON including a bell in a braſs recipient, and placing it at one end of a room, about 50 yards in length, at the other end of which ſtood ſome gentlemen to obſerve the ſound; before any air was intruded, the bell, upon ſhaking, was heard at that diſtance, tho' not without diligent attention; upon the intruſion of one atmoſphere, or quantity of air, the bell being ſhaken as before, the ſound was very ſenſibly augmented; two atmoſpheres being impelled and the bell made to ring, a notable improvement of the ſound was then manifeſt; but upon the intruſion of the third, fourth and fifth atmoſpheres, the bell being made to ſtrike, the ſound ſeemed not to be propagated proportionably to the firſt and ſecond; which might happen by means of ſome eſcapes of air, the valve which ſhould have hindered the return of the injected air, not holding ſo tight as it ought, but that ſome of the intruded air repaſſed into the ſyringe; by which means the quantities ſuppoſed to be injected were deficient

another

another reaſon why, the latter atmoſpheres did not propagate the ſound as the two firſt had done, is this; tho' 25 compreſſions of the ſyringe are equal to the natural contents of the recipient, yet, when the air becomes pretty ſtrongly condenſed, as by the intruſion of four or five atmoſpheres, the remaining air at every ſtroke, which will lie between the bottom of the *Embolus* and the valve (tho' but little) is at the ſame denſity in the ſame time, as the air in the recipient; which upon drawing up the forcer, will extend itſelf to ſupply ſuch a ſpace of the cylinder, as ſo much common air; and is ſo much ſhort of what ſhould be injected at every ſtroke, 25 of which become equal to the natural contents of the receiver; hence, the deficiencies of the real atmoſpheres, or quantities by a certain number of ſtrokes, may be very conſiderable, and it may be very difficult to account for them: Notwithſtanding the deficiencies are not known, (yet at the end of the five, tho' imperfect) atmoſpheres, the bell being ſhaken as at firſt, it was the opinion of a gentleman then 50 yards diſtant, that the ſound ſeemed to be almoſt as ſenſible, as when it came to be made and expoſed in the open air.

June the 9th about five in the morning, Mr. *Hauksbee* repeated this experiment in an open field, called *white Conduit*, ſituated to the weſt of *Iſlington*, with much the ſame ſucceſs as the former; upon ſhaking the bell, before any air was intruded, it was but juſt audible at 30 yards diſtance; upon the injection of one atmoſphere, it became then as audible at 60 yards, as it was before at 30; a ſecond being intruded, the bell upon ſhaking, might then be heard at 90 yards diſtance; but after that, tho' near 100 ſtrokes of the forcer were repeated, yet it could hardly be heard 20 yards farther; which Mr. *Hauksbee* attributed to the reaſons before given; the morning was very miſty, which cauſed a great dew upon the graſs; there was little or no wind ſtirring; and the ſilence, requiſite in making ſuch an experiment nicely, at laſt began to be interrupted by the noiſe of the five o'clock bells and other noiſes that joined with them from *London*, contributing in ſome meaſure to the unſucceſsfulneſs of the latter part of the experiment.

A bell being included under a receiver, and ſhaken, to make the clapper ſtrike, it was very obſervable, that the interpoſition of the glaſs betwixt the bell and the ear, was a great obſtruction to its ſound, notwithſtanding, it was audible at ſome good diſtance from it; but upon gradually exhauſting the air, and making ſeveral ſtops to ſhake the bell at different degrees of rarefaction, the diminution of the ſound at every ſtop was very diſtinguiſh-

able;

able; till at laſt, when the receiver was well exhauſted of air, the remains of ſound were then ſo little, that the beſt ears could but juſt diſtinguiſh it; it ſeeming to them like a ſmall ſhrill ſound at a great diſtance; upon permitting the air to re-enter, not all at once, but by degrees, it was eaſy to perceive the increaſe of ſound, at the different times the bell was made to ring; the recipient being again replete with air, the ſound ſeemed then ſomewhat more clear, and audible, than it did upon its being firſt included.

The Figures of the Salts *of* Chryſtal; *by M.* Leewenhoeck. Phil. Tranſ. N° 298. p. 1906.

M. *Valkenier* ſhewed M. *Leewenhoeck* cryſtals, amongſt ſeveral, one remarkable, as big as his fiſt, which looked like ſo many ſmall flints joined together; they ſeemed to be united by very tranſparent particles, which might be called wild cryſtal; and upon viewing the ſaid cryſtalline particles, the largeſt prominent points of which ſeemed no bigger thro' the microſcope than a coarſe grain of ſand, ſeveral of them appeared to M. *Leewenhoeck* to be hexangular, like mountain-cryſtal: M. *Valkenier* farther told him, that in ſome of the higheſt mountains of *Switzerland*, the large and ſmall ſtones were almoſt mixed, or united with the wild cryſtal; which mountains are therefore called by the natives *Nagelfelſen*, i. e. *the nail mountains* or *rocks*, by reaſon of the great number of prominent points therein: M. *Leewenhoeck* ſtruck off four or five ſmall flints from one of theſe ſtones, whereupon ſeveral of the ſaid wild cryſtal particles came off together; which he placed before a microſcope, and obſerved that each of them was almoſt of a different figure, tho' moſt of them run into an hexangular point of ſeveral ſizes; in breaking them from each other, the ſides aſſumed particular figures, which appeared as if they were compoſed of nothing but long particles, all as bright and tranſparent as any cryſtal, excepting only in thoſe parts where they were joined to the ſtones; the cryſtal particles lay very cloſe upon each other, and were ſo ſmall, that upwards of 100 of them were not equal to one of our cryſtal particles; amongſt others, he obſerved ſome, no bigger than a coarſe grain of ſand, which conſiſted of 100 other ſmaller particles, all very tranſparent, and appearing thro' the glaſs like a little mountain of cryſtal, which was a very agreeable ſight; he likewiſe obſerved ſeveral cryſtal particles, which inſtead of terminating in one hexangular point like others, conſiſted of ſeveral ſharp ones, ſome of which were very different both in length and

and thickneſs from the reſt, which confirmed him in his opinion, that they were coagulated out of long particles; he obſerved, that where the little flints did not lie very cloſe to each other, the void ſpace, as it appeared to the naked eye, was alſo filled with the ſaid chryſtalline matter; but when he came to view them more narrowly, he could perceive that thoſe cryſtalline parts were indeed united to the little flints, but that there were ſeveral ſmall cavities between them; from whence he concluded, that the flints lying ſo upon each other, as we now find them, a fluid cryſtalline matter, out of which all the cryſtals were coagulated, had inſinuated itſelf between them; and where they were not ſo cloſely joined, there did not happen to be enough of that cryſtalline matter to fill up the vacant ſpace.

Plate XII. Fig. 28. A B C D E F repreſents, as it appeared thro' a microſcope, one of the ſaid cryſtal particles; wherein may be obſerved at A B C, and partly alſo between D F, how it had been joined, and how it had alſo been broken off from other cryſtalline particles; between D E F is that part, from whence proceed ſeveral prominent points.

Fig. 29. G H I K L M N repreſents a larger particle of cryſtal, which had been joined to another that lay by it; in G H I K O is ſhewn that part which had not been united, and in which, as far as it is poſſible, the ſeveral prominent points are repreſented by L M N G O; he found that theſe aforeſaid cryſtalline particles were eaſily ſeparable; to make a further trial of their ſoftneſs, he placed a particle thereof no bigger than a grain of ſand upon a plate, and then preſſing it with his thumb-nail, it broke into 1000 little pieces; which ſeemed the more ſurpriſing to him, becauſe it is generally known, how hard mountain cryſtal is: From this experiment, M. *Leewenhoeck* ſuppoſed, that what we call wild cryſtal is moſtly ſalt, if perhaps, it be not all ſo; to make a further trial thereof, he took about the bigneſs of a pea of the ſaid cryſtal, which he had broke off from a flint, and laying it upon a ſilver ſmith's wood coal, he put it into a glowing heat, and then throwing it into ſome pure rain-water, it was immediately diſſolved into white powder; but viewing the ſame with his microſcope, he ſaw that there ſtill remained ſome particles as big as a grain of ſand; the ſmall quantity of water, wherein the cryſtal lay, having ſtood about ¼ of an hour, he obſerved that its ſurface was covered with a thin ſcum, of which taking a little (as he again did when the ſcum was grown thicker, after the ſpace of three or four hours) and placing it before a microſcope, he obſerved, that beſides ſeveral ſmall particles, whereof the

the ſcum for the moſt part conſiſted, there lay a vaſt number of ſalt particles, of very different figures; ſome of them were long, others quadrangular and others again of hexangular figures, and all of them appeared to be ſolid cubical bodies; their longeſt ſides were parallel to each other; and when he viewed theſe coagulated ſalts, ſome of which lay upon the ſurface of the water, as others had ſubſided to the bottom, he obſerved that they were not only grown larger, but that each of them was incompaſſed with ſeveral circles: Moreover, where the water was exhaled, there lay ſuch a vaſt number of ſmall ſalt particles, that they eſcaped in a manner the ſight; inſomuch, that it was impoſſible to diſcover any figure; and in ſome, that were ſtill ſmaller, there was nothing more to be ſeen, but an exceeding ſlenderneſs and length, juſt as very ſmall particles or threads of wool appear to the naked eye; from which obſervation, he ſuppoſed, that in caſe he had put the water a little thicker together, inſtead of ſpreading it upon the glaſs as thin as it was poſſible, the coagulation of the ſaline particles would have been thicker and larger; he alſo concluded, that moſt of thoſe very ſlender and long particles were of the ſame figure with the larger ones; when a great many of thoſe very tranſparent, and as it were cryſtalline ſalt particles were become dry, their tranſparency did in a manner vaniſh, and they became opaque bodies; in which a perſon could not perceive the leaſt tranſparency, they appearing to be a white matter: This diſcovery made M. *Leewenhoeck* imagine, that whereas, one of thoſe aforeſaid particles, whilſt it had any moiſture about it, was always increaſing, by a confluence or coagulation of vaſtly ſmall ſalt particles, all ſo firmly united to each other, that they ſeemed to be ſo many cryſtals; ſo when that ſome moiſture was entirely exhaled, the coagulated particles were preſently ſeparated from each other; yet the ſolution was not ſo efficacious as to deprive them of the figure they had, but only to diſſolve their conjunction; ſo that inſtead of being one tranſparent body, they became ſeveral bodies, that did not admit the light, but appeared white to to the eye; and he likewiſe ſuppoſed, that when the water was exhaled at laſt, thoſe very ſmall ſalt particles, whoſe figures by reaſon of their ſmallneſs, had altogether eſcaped his ſight, were not coagulated upon the large ſaline particles, and ſo deprived them of their tranſparency; whereas the ſalt particles, that were more thinly coagulated, preſerved their tranſparency, but theſe were but very few: After that the abovementioned water had ſtood ſeveral days upon the wild cryſtal, which had been thrown into it glowing hot, he put a very

ſmall

ſmall piece thereof upon a clean glaſs, and placing the water ſo as that there came but very little air to it, he then could perceive but a very little coagulation of the ſalt particles; but upon placing the ſame water in the air, he ſaw that a great many ſalt particles were coagulated; in ſhort, there was almoſt an incredible number of exceeding ſmall particles in a little quantity of water that lay within the compaſs of a ſingle pea: Moreover, M. *Leewenhoeck* taking ſome of the ſalt particles that lay upon the ſurface of the water, after it had ſtood about eight days, he obſerved at the ſame time, that they were not only coagulated into larger maſſes, with very neat, ſmooth ſides and ſuperficies, but that they were alſo become much thicker, as well as broader and longer, that they appeared to be ſolid cubical bodies of cryſtal; yet he could not diſcover, in a great number of thoſe ſalt particles, any two that were ſimilar: Now upon finding that the wild cryſtal, after having been heated glowing hot, had diſſolved itſelf into ſuch a vaſt number of ſmall particles in the water, he took a ſmall copper porringer, whoſe cavity formed half a globe, and having cleaned it very well, he put a little of the ſaid cryſtal into a ſmall quantity of water, and placing it over a wood coal, it boiled in the ſpace of a minute, and he kept it there till the water had almoſt evaporated; after which he mixed the remainder with rain-water, and put ſome of the ſame upon ſeveral clean glaſſes, in order to ſee whether the water, by the abovementioned boiling, was not alſo impregnated with ſalt particles: This water being moſtly exhaled, he diſcovered therein ſeveral ſalt particles, almoſt of the ſame figure with the former; but foraſmuch, as the water wherein the wild cryſtal had been put glowing hot, was entirely exhaled, the laſt glaſſes were altogether covered with a vapour, which moſtly ſurrounded the ſalt particles, which he ſuppoſed to be very ſoft, and they were alſo covered with a very thin membrane: To be further ſatisfied about the laſt obſervation, M. *Leewenhoeck* heated the glaſs whereon the laſt ſalt particles lay, till the vapour or moiſture was quite exhaled, and then he could perceive a great many ſmall ſalts, that he had not ſeen before, but nothing near ſo many as were in the firſt water; after the ſpace of about an hour, it being moiſt weather, when he viewed the glaſs again, he found that the wateriſh vapour lay ſo thick about the ſalts, as if none had been exhaled.

Fig. 29. repreſents between P and Q a ſmall ſalt particle, wherein lay another, that according to all appearance, was at firſt

coagulated, and afterwards arrived at that bigneſs, when the water was quite evaporated.

Fig. 30. repreſents between R and S another ſalt, having alſo within it a coagulated particle, which has at R two right angles, and at S an acute one, both the long ſides thereof running parallel, and at equal diſtances from each other, and there were a great many of that figure.

Fig. 31. T U repreſents an hexangular ſalt particle, wherein alſo lay a ſmaller one of the ſame ſhape, and which was very thick.

Fig. 32. repreſents between W and X, a ſalt particle, whoſe ſuperficies formed an exact ſquare; he met with very few of ſuch figures, eſpecially where the water had lain thick.

Fig. 33. Y Z. repreſents a particle, of which he diſcovered an exceeding great number, tho' they were very thin.

Fig. 34. ſhews between A and B another ſalt particle, whereof there was a vaſt number coagulated in the water: After M. *Leewenhoeck* had made a great many experiments in the laſt-mentioned water, till it was quite exhaled; and having alſo poured freſh water twice upon the ſaid wild cryſtal, he was ſurpriſed to ſee, that each time there was a coagulation of new ſalts upon the ſurface of the water; but moſt of them were ſo very ſmall, that they appeared thro' the microſcope no bigger than a grain of ſand to the naked eye; yet he could very plainly perceive their figures, and the more, becauſe they were all very tranſparent; and whereas, a great many ſalt particles are ſo ſoft, that in moiſt weather they are diſſolved into a watry vapour, theſe were ſo hard and likewiſe ſo dry, as if they had been ſalts of chalk; and upon ſhaking the glaſs wherein they were, they came off from it, eſpecially ſuch as were pretty large: After theſe obſervations, he again viewed with a microſcope, ſeveral pieces of rock cryſtal, as broken off from the ſtone, wherein he had formerly diſcovered amongſt other figures, ſuch as are repreſented in Fig. 31. between T U; and now obſerving an hexangular piece of cryſtal, which alſo terminated in a point of the like ſhape, he diſcovered therein ſeveral ſmall pointed blue cryſtals, as in Fig. 53. between C and D; they were of ſeveral ſizes, and ſome of them were of a finer blue than the reſt; he alſo diſcovered in another piece of cryſtal much the ſame figure, but none of them were blue, ſome of which were as tranſparent as cryſtals, and others again as dark, as if it had been nothing but a blackiſh earth; and ſome of them lay much deeper in the cryſtal than others;

he

he had one piece of cryſtal, wherein he reckoned upwards of 30 little blue figures, ſuch as are repreſented in the laſt figure; and ſome of them were ſo very ſmall, that they appeared no larger thro' a microſcope, than a grain of coarſe ſand to the naked eye; and as far as he could judge of them, they were moſtly hexangular; but he obſerved, that ſome of them were not ſo perfect and regular as the reſt, having one point larger than the others, as repreſented in Fig. 36. between E F; he alſo obſerved a little figure, that was exactly of equal ſides, only, that its fore-ſides ran obliquely, and its ſuperficies alſo conſiſted of an exact quadrilateral figure; it was moreover, as bright as cryſtal, appearing juſt like one of thoſe common diamonds, called thick ſtones; yet it is very ſurpriſing to ſee the above-mentioned figures incorporated in ſuch a hard ſubſtance; ſome lying near the ſuperficies of the chyſtal, and others much deeper: M. *Leewenhoeck* had a piece of rock cryſtal about a finger thick and an inch long, that was hexangular, and terminated in an hexangular point; upon one ſide could be diſcovered with the naked eye, little cavities or holes, about the bigneſs of half a nail, which ſeemed for the moſt part, to be filled with an earthy matter; but when he placed the ſaid cryſtal before his microſcope, his opinion of it was, that whilſt it was growing, or coagulating, ſeveral little inſects running upon it, were intangled or impriſoned therein; the rather, becauſe ſome other particles lay ſtill deeper in the cryſtal, and ſo were altogether ſhut up in it; the bodies of theſe inſects or worms conſiſted of very ſmall and ſlender circles, or annular particles, as M. *Leewenhoeck* frequently obſerved in in ſuch *Animalcula*.

Fig. 37. G H I K. repreſents, as it appeared thro' a microſcope, a ſmall part of one of theſe ſeeming inſects, that lay pretty deep in the cryſtal; he could ſee this part no further, becauſe its extremities G and I were covered with other ſuch like particles; and this alſo was the largeſt he could diſcover amonſt them; for the other particles were broken into much ſmaller pieces; amongſt all he obſerved, there was but one particle that terminated in a point, and that he judged to be a part of the tail, as he ſuppoſed another had been the head; he alſo ſaw two ſmall particles that were equally green, as were ſeveral other little pieces of inſects: He had two pieces of cryſtal, of which the ſmalleſt was above an inch thick, and hexangular, wherein he diſcovered ſeven long particles, the largeſt of which was no thicker than a hair of the head; they were

of a dark grey colour, and had at one extremity ſeveral thinner particles, or ſmall fibres branching out; ſome others were much finer than a ſingle hair, and ſome were of an exceeding fineneſs: In another thicker cryſtal, he ſaw above 25 more ſuch like particles, and tho' he broke that cryſtal into pieces, in order to diſcover what matter theſe particles were compoſed of, yet he could not ſucceed therein; he indeed ſaw, that one of them had a ſort of cavity, and was round; another flat, without any cavity; and he could perceive, in another piece of the broken cryſtal a triangular long particle, that was hollow; this laſt was very inviſible, becauſe one extremity thereof lay oppoſed to his ſight; he alſo ſaw another very plainly that was triangular, two of whoſe ſides were a third part broader than the other; but he could not be poſitive, whether it was hollow or not; he alſo ſaw another long particle that was quadrilateral, whoſe two oppoſite ſides were twice as broad as the other two; and foraſmuch as he was well aſſured, that it could never have been any hair, or particles of wool; and as he had never ſeen any vegetable, that produced ſuch fine ſlender parts, he could not conclude, what ſort of ſubſtance it was, and much leſs, how they could come into the cryſtal, wherein they lay a-croſs or athwart each other.

M. *Leeuwenhoeck* obſerved before, that when he placed ſuch rock cryſtal over the fire, it burſt into a great many pieces; from whence he inferred, that therein muſt be ſhut up either ſome vapour, or elſe particles of ſalt, that occaſion'd its breaking into ſo many pieces; to diſcover which, he put into a little glaſs, ſeveral ſuch broken bits of cryſtal, and he obſerved, that a very little quantity of moiſture and ſalt was extracted therefrom by the fire; but when he dropped into water ſome of thoſe pieces of cryſtal, as glowing hot as he could make them, he could not diſcover, as he had done in others, any ſalt particles coagulated upon the ſurface of the water; however, he took a few more pieces of cryſtal, and placing them upon a wood coal, he dropped into ſome clean rain-water, the ſmall remainder which had not been ſublimed by the heat; and tho' he could diſcover no ſalt particles upon the ſurface thereof, yet ſeveral times he took ſome of the ſaid water, and poured it upon very clean glaſſes; and after it had ſtood ſome time, both in moiſt and dry weather, he viewed it often, and always perceived that there lay a great many coagulated ſalt particles of different figures, but he could not diſcover the exact figure of moſt of them, becauſe the water had not exhaled; yet he ſuppoſed

poſed, that there were ſalts of two kinds therein, *viz.* the ſalts that were already coagulated, and other ſalts that ſurrounded theſe; he viewed theſe ſalt particles in the afternoon, and in clear weather, in the month of *April*; and next morning about 6 o'clock; he perceived, that they were ſurrounded with ſo many ſeeming watry particles, as made it a ſurpriſing ſight; when he had a very clear view of the ſaid ſalt particles, he obſerved amongſt them ſome of the ſame figure with the cryſtals, *viz.* hexangular; and as the rock cryſtal was of an hexangular figure, terminating in points of the ſame ſhape; ſo likewiſe had theſe coagulated ſalt particles two hexangular points, as repreſented by Fig. 38. between L and M.

M. *Leewenhoeck* ſuppoſed, that in caſe the rock-cryſtal in its coagulation had lain in ſuch a poſition, as not to be united at both extremities, but only in the middle, they would then have been compoſed of two hexangular points, as we ſee in ſalt-petre; which in coagulating in the water, and faſtening one of its ſides to any other ſubſtance, is not only hexangular, but its extremities which run into a point, are not always hexangular like cryſtals, but oftentimes of the form of a chiſſel.

Fig. 39. repreſents in N and O a little particle of cryſtal, which tho' very ſmall, he could perceive to be of a triangular figure, two of its angles being larger than the third; he alſo obſerved, ſome ſalts reſembling Fig. 34. between A and B, having a thickneſs which was viſible to the naked eye; beſides, a great many other irregular ſalt particles, which were very numerous in a ſmall quantiry of water; he cauſed the water, that almoſt always ſurrounds the ſalt particles, to exhale leiſurely by the warmth of a candle; and then he could diſcover a great many ſmall coagulated ſalts without any diſcernible figure.

An Account of Lake Vetter, *in* Sweedland; *by Dr.* Urban Hearne. Phil. Tranſ. N° 298. p. 1938. *Tranſlated from the* Latin.

LAKE *Vetter* lying from north to ſouth, is from *Askerſund* of *Nericia* to *Jonekoping* of *Smoland*, 14 *Swediſh* miles in length, (one of which makes five or 6 *Engliſh* miles, and 10 of them almoſt a degree) it is three miles in breadth, and in ſome places hardly two; it divides *Gothland* into two parts, the one ſituated to the eaſt, is commonly called *Oſtrogothland*, and the other to the weſt, *Weſtrogothland*; on the *Oſtrogoth* ſide lies the famous mount *Ahme* or *Ohme*, as alſo the city and caſtle of *Vadſtein*; and on the *Weſtrogoth* ſide ſtands

ſtands the ancient town of *Hio*; the lake itſelf, by reaſon of the high ridges of mountains, that in ſeveral places ſtand cloſe to its banks, and in other places at ſome diſtance therefrom, always appears depreſſed on the ſides; it is of a conſiderable depth, yet ſo unequal, that in ſome places it cannot be ſounded with 80 fathoms, and in ſeveral places on the *Oſtrogoth* ſide, and in ſome few on the *Weſtrogoth* ſide, not with 300 fathoms: One *Benedict Amberni*, a citizen of *Vadſtein*, ſounding the depth of lake *Vetter*, hard by *Groenenburg*, let go ſeveral fathoms of line, to which he had faſtened an ax inſtead of a plummet, but he could find no bottom; there is ſuch another abyſs at the precipice of mount *Ohme*, called the *Weſtern-wall*; ſo that there is no coming near it with ſafety for fear of the weſt wind, which ſuddenly riſing, ſoon drives their boats, notwithſtanding their throwing out anchors on all ſides, againſt theſe declivities; in like manner Count *John Oxenſtiern*, having attempted to try the depth at a certain place of *Weſtrogothland*, with 300 fathoms of line, could find no bottom; this lake is not only deep, but its waters are clear, ſo that at a conſiderable diſtance one may ſee a ſmall piece of money at the bottom; a little below the ſurface, the water appears tinged as it were with green; and indeed it is ſurpriſing, that the filth conveyed into it from ſo many marſhes, mountains and woods, ſhould not in the leaſt affect its clearneſs: Tho' lake *Vetter* exceeds ſeveral other lakes in largeneſs, yet for the moſt part it is free from rocks, and has but very few iſlands; the principal of which (where the counts of *Brahe* formerly had their ſeat) called *Viſingſoe*, lies in the middle of the lake, between *Groenenburg* of *Smoland* and *Weſtrogothland*, as the iſland *Rokne* does to the north, and directly oppoſite to the mineral ſprings of *Medevien*; there appear other iſlands cloſe to the ſhore, but they are both very few in number and ſmall; ſeeing then lake *Vetter* is thus expoſed to the winds, and ſurrounded on all hands with high mountains, it is not ſurpriſing, that it ſhould be ſeldom calm, and that being frequently agitated with ſtorms, its high and confined waves ſhould beat violently upon boats, and other veſſels; and that oftentimes ſo ſuddenly, that the waters, which appear as ſmooth as a mirrour, begins to be in commotion, before the leaſt breath of wind is perceived; which ſeems to be owing to a tempeſt, ariſing ſomewhere from under the waters, and gradually protruding them; for it is no uncommon thing for boats to be toſſed with a violent ſtorm in one part of lake *Vetter*, whilſt others not far off, are forced to

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row by reaſon of the calm; and that ſuch eruptions of waters are copiouſly promoted by ſubterraneous winds, ſeems to be confirmed by various phænomena; for immediately before a ſtorm, and whilſt the ſky is ſtill clear, there is perceived a hideous noiſe like thunder in the waters, which Dr. *Hearne* himſelf had often heard, whilſt the air was very calm, and which was always followed by a great ſtorm; this the inhabitants of *Viſingſoe* perceive more ſenſibly than any others; for from that part of the iſland, whence the winds are to ariſe next day, their ears are ſtunned with a confuſed ſort of noiſe, like that of the firing off cannon; and when theſe bellowings are heard in the eaſt, commonly the eaſt wind blows with hail and rain; it is worth while to conſider thoſe various ſufflations, and ſudden riſing of vapours and exhalations, that ſome have obſerved on this lake; which is alſo confirmed by *Abraham Winandz*, who travelling that way, obſerv'd whilſt the waters were very calm, a great number of little clouds, like ſo many darts, proceeding here and there from the bottom of the lake, and which uniting in the air, formed a misſling rain; all which plainly ſhews, that this is very much owing to ſubterraneous winds; and the ſame ſubterraneous wind, undoubtedly, together with that from above, is the cauſe, why in ſpring, the ice which this moment is ſtrong and thick enough to bear horſes and ſledges, is entirely melted the next; whereby, ſo ſudden a thaw is occaſioned over all the lake, that where you could a little before be carried with ſafety by horſes, there now you might ſail in a boat; theſe ſurpriſing bellowings of the waters, that preceed this terrible eruption, warn travellers to make the beſt of their way; and ſuch of them as are at ſome diſtance from land, are either directly drowned, or obliged to float for ſome time upon ſhoals of ice, in continual peril of their lives; ſometimes, the ice with the leaſt blaſt of wind ſinks ſuddenly to the bottom: Whether metalline exhalations contribute to raiſe theſe ſubterraneous winds, the Dr. will not determine; but that there are ſuch in this place is plain, from the various mountains ſituated to the northern parts of lake *Vetter*, *Nericia* and *Weſtrogothland*, which are repleniſhed with veins of iron, and perhaps nobler metals, as alſo with ſeveral ſpecies of minerals; as antimony, magneſia, lime-ſtone, different lead ores, oker and pyrites, from which ſulphur, vitriol, allum and other mineral juices, are uſually extracted; and even in the very waters there is found a great deal of pyrites, and lumps of a certain kind of ferruginous oker, little pieces of which the Dr. himſelf had often

often gathered; to this is owing the *Ignes fatui*, which are not only frequently obſerved on ſhore, but are likewiſe in the night-time ſeen flying about the middle of the waters, and dazzling the fiſhermen; and this ſeveral take to be owing to metallic and ſulphureous exhalations; and indeed, without mineral vapours, granats, porphyries, jaſpers, cryſtals and other precious ſtones could not be generated in this lake; and theſe bear ſo good a poliſh as to be uſed for wedding ornaments, all which ſhew their metallic original.

Amongſt the other properties of this lake, its ſurpriſing whirlpools and violent currents, under water are no leſs remarkable, and which directly oppoſing the winds and waves give a great deal of trouble to the fiſhermen; from hence it is ſuppoſed, and by reaſon of its unfathomable depth, ſecret ſtreams and ſubterraneous winds, that there is a communication under-ground between this lake and lake *Venner*, which is diſtant 10 *Swediſh* miles to the weſt; and this ſeems to be confirmed by the ſeveral whirlpools that lie between theſe lakes two of which (in the pariſh of *Fægre*) called the white and black whirlpools, *Haddorphius* a famous *Swediſh* antiquary, ſounded and found them vaſtly deep, and in them obſerved an inteſtine motion, and ſwelling as if they fermented; what further countenances this opinion is, that ſome years without any viſible cauſe, the waters increaſe, and remarkably decreaſe again the following years: M. *Daniel Rydelius*, paſtor of *Motala*, obſerved, that lake *Vetter* for theſe ſeven years paſt, had fallen in ſome places ſo ſenſibly, that he could walk dry for ſeveral fathoms, where formerly he was obliged to go in a boat, tho' there had been a great deal of rain; as in the years 1680, 1682, 1684 and 1685; but in the year 1686 towards autumn, the waters were obſerved to increaſe again gradually to the year 1688; whether lake *Vetter* ſwells at ſtated times, as thoſe who ſounded lake *Venner* contend, that it riſes and falls every 7 years alternately, Dr. *Hearne* cannot determine; it is alſo remarkable, that the firing off cannon at *Stockholm*, and other places 30 miles diſtant, is in a clear day ſenſibly perceived here.

As to the accounts *Olaus Magnus*, *Meſſenius*, and other hiſtorians, give of *Gilbert*'s cave, in the iſland *Viſingſoe*, the Dr. leaves their authors to anſwer for them; it is true, there is a cave, which yields a ſulphureous and nauſeous ſtench; owing as he ſuppoſes, to the cave being ſituated in a marſh near the water, and to the dirt collected by length of time therein, from

from which are exhaled ſulphureous and moiſt vapours; rather than to any of the cauſes commonly alledged for it.

The river *Motala* is the only mouth whereby lake *Vetter* diſcharges itſelf; at certain times, it loſes as it were, its fluidity, and is ſo ſtopped up in its courſe, that a perſon may ſafely enter it, and ſometimes eaſily catch the fiſh that are left in the channel, as happened about *Chriſtmas*, 1682 and 1685, and according to the natives, this always portends famine, war, or ſome public calamity; tho' thoſe who live hard by this river endeavour to account variouſly for this phænomenon; as by ſuppoſing that at that very inſtant the waters receeding from their banks, ſink to the bottom; yet the Dr. ſuſpects, that the lower parts thereof are obſtructed either with ice or ſnow, and that theſe are a kind of bulwark to the inferior waters, which in the mean time diſcharge themſelves into the ſea; and what made the Dr. think ſo, was, that this never happens in ſpring, ſummer or autumn, but always either at *Chriſtmas*, or at the beginning of the new year; becauſe, this always happens near a bridge, where the water not being above three ells deep, the bulwark and ſtones, that defend the bridge, ſtop the courſe of the river; this opinion is confirmed, from thoſe iſicles and congealed ſnow that adhere to the longer weeds that grow at the bottom, which driven down by the current towards the foundation of the bridge, muſt in time be accumulated, and that to ſuch a degree, as to ſtop the courſe of the river; and the millers thereabout affirm, that immediately before this obſtruction of the ſtream, large lumps of ſnow are conveyed from the lake, which ſticking like glue to whatever bodies they meet with, do gradually ſink to the bottom; nor is it unuſual for the waters to be one day quite calm all over the lake, and the next, by being put into a commotion, to be ſtopped at the bridge; whatever may be the cauſe thereof, it is ſtill ſurpriſing, that this obſtruction happens not in the ſevereſt cold weather, but in a milder ſeaſon, and that generally about *Chriſtmas*, and *New Year's-day*; perhaps, the rigour of the cold ſtill remains under water, tho' it may be abated in the open air; or perhaps, the ice being but gently frozen, and detain'd by weeds and other things that come in its way, occaſions theſe obſtructions.

There is a certain fountain not far from lake *Vetter*, near the church of *Nye*, called the hungry or prophetic fountain, becauſe it never has plenty of water, but when there is a

ſcarcity of corn and proviſions the following year; it is encompaſſed with crumbling ſandy hills, between which lies a low vale, without any marſhes, from which this ſpring proceeds by ſecret paſſages; wherein this is remarkable, that in a rainy ſummer it is commonly dry, whereas in the drieſt ſummer, upon an approaching famine, or as ſome ſuppoſe, an impending war, it overflows the king's highway at *Motala* and *Vadſtein*, as ſeveral living thereabouts can teſtify: In 1685, which was a very rainy year, this fountain was entirely dried up; in the ſummer of 1686 the water was obſerved to increaſe; and the very dry ſummer of this preſent year 1705, will not permit us to call in queſtion the truth of this relation; for when all neighbouring fountains were quite dry, this had a very plentiful ſtream: What is principally worth obſerving is; 1. That of all the places that are near this fountain, a ſcarcity is threatned only to *Oſtrogothland*. 2. That in all this country, eſpecially near the fountain, the ſoil is ſandy and in ſome places hard and clayey, to impregnate which, a ſufficient quantity of moiſture is always requiſite. 3. That therefore corn is ſcarce in thoſe parts, only in dry ſeaſons; whilſt it is otherwiſe in *Jemptia* and ſome other northern provinces. 4. That meteors and ſtorms ſometimes follow the genius of the ſoil. 5. That the waters of this fountain, being as it were ſtrained thro' the ſand, are collected near theſe ſandy hills. 6. That it is poſſible from phyſical cauſes theſe waters may increaſe or aſcend in a dry, and decreaſe or ſink again in a wet ſeaſon.

Experiments on the Reſilition *of Bodies in common* Air, in Vacuo, *and in condenſed Air, as alſo on the Deſcent of Malt Duſt* in Vacuo; *by Mr.* Francis Hauksbee. Phil. Tranſ. N° 298. p. 1946.

MR. *Hauksbee* having provided a tall receiver, in the upper part of which he had a contrivance to lodge four marbles, and from thence he could at pleaſure drop them ſucceſſively upon a plane; the diſtance of the deſcent of each marble on the plane was about 13 inches and a half; the weight of two marbles was 59 grains, and that of the other two was 63 grains; the plane whereon they dropped was a round flat piece of ſolid glaſs, about an inch thick, and three inches and a half over, its upper ſurface was well ground and poliſhed, it was fixed in a tin frame, contrived on purpoſe to keep its lower ſurface from being contiguous to the plate or leather, on which the recipient was placed

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upon dropping the marbles upon the ſaid glaſs-plane, the reſilition was ſomething more than that in common air; and thoſe dropped in common air, had likewiſe ſome ſmall advantage in their rebound, above thoſe let fall in condenſed air, the condenſation being but one atmoſphere; for any more would endanger the breaking of the receiver; the reſilition of the marbles from the plane *in Vacuo*, was about 10 inches and $\frac{1}{2}$, which was ſomething more than $\frac{3}{4}$ of their deſcent; in condenſed air their rebound was about 10 inches; ſo that we muſt account their reſilition in common air, to be the medium of the other two; it being difficult to judge to a nicety in ſo ſudden a motion; but there was a ſenſible difference between thoſe dropped *in Vacuo*, and thoſe in condenſed air: Mr. *Hauksbee* could not obſerve, that the ſmall difference in the weight of the marbles made any diſcernible alteration in their reſilitions.

Mr. *Hauksbee* took ſome malt-duſt, and having dried it well, he put a quantity thereof into a fine muſlin bag, where being looſely incloſed, it would, upon ſhaking, diſcover itſelf plentifully in the open air, undulating and floating a conſiderable time, before it would deſcend; but upon being included in a receiver, from which the air was well exhauſted, and then ſhaken, the duſt deſcended like a ponderous body, precipitating in ſtreight lines from the top to the bottom of a tall receiver.

Offifications *or* Petrifactions *in the Coats of* Arteries, *particularly in the Valves of the great Artery*; *by Mr.* Cowper. Phil. Tranſ. N° 299. p. 1970.

HOW far anatomical enquiries inform us as to the true ſeats and cauſes of diſeaſes, which have been aſcribed to the want of ſpirits in ſome, and of radical moiſture in others, eſpecially aged people, *&c.* may be ſeen in ſome meaſure by the two obſervations, amongſt others, in *Phil. Tranſ.* N° 280; ſince which Mr. *Cowper* met with ſeveral like inſtances in aged people, particularly in the leg of an old gentleman, whoſe toes and foot were ſphacelated; the diſſection of morbid bodies, does likewiſe very often informs us of the true uſe of the parts, as appears by the following inſtances; the oſſification or petrifaction in the great artery, at its riſe from the heart, has been obſerved ſo commonly, that ſome take it to be conſtant; how it may be in ſome animals, Mr. *Cowper* cannot certainly ſay, but in human bodies he is well aſſured, that whenever it happens, it is a diſeaſe, and in ſome meaſure incommodes thoſe parts in the proper execution of their functions, as is evident from the following caſes; a thin

man about 30, who languiſhed with an ulcer in the thigh, a
tended with a *Caries*, or rottenneſs of that bone, at its articula
tion with the *Tibia* and *Patella* called the knee, where all the
bones were affected, at length fell into a true *Phthiſis*, and h
coughed up a great quantity of *Pus*; ſome months before th
patient's death, Mr. *Cowper* frequently ſaw him, when he woul
often offer him his wriſt, to feel his unequal pulſe; the arter
there miſſing ſometimes one, ſometimes two ſtrokes in ſix or ſ
ven; at firſt the patient told Mr. *Cowper*, that he obſerved
miſſed but one in ten; but at length theſe ſtops become mo
frequent, eſpecially, on any agitation of the body or mind; th
a *Polypus* in any of the large veſſels about the heart may induc
that ſymptom, yet its continuance ſo long before death, ſhews
owing to ſome other cauſe, as appeared, on opening the heart an
great artery of this perſon.

Plate XIII. Fig. 1. repreſents the trunk of the great arter
opened and diſplayed; *a a a* the three ſemilunar valves of th
Aorta, which hinder the blood from returning to the heart, aft
it is expelled thence by its *Syſtole* or contraction; theſe valv
were in this caſe ſomewhat thicker, and not ſo pliable as the
naturally are, and they did not ſo adequately apply to eac
other, as is expreſſed by *a a a* Fig. 4; whence it happene
ſometimes, that the blood in the great artery A A A Fig.
would recoil and interrupt the heart in its *Syſtole*; but this ſtu
bornneſs of theſe valves was owing to a bony or ſtony ſubſtan
repreſented by *b* in the ſaid Fig. which appeared much plain
when the valves were dry, as repreſented in Fig. *; *a a* the tw
valves ſtretched out and dried; *b* the petrifaction or ſtony ſubſtan
at their conjunction; in this inſtance, Mr. *Cowper* obſerved th
left ventricle of the heart, expreſſed at G G, D D, *e e*, *f f* Fig.
to be a little dilated from its natural ſize, but was not by th
parts in three ſo big as the left ventricle of the heart of anoth
ſubject he had diſſected; the ſymptoms for ſome years befo
the death of this perſon, who was about 30 years of age, we
an extraordinary ſhortneſs of breath, eſpecially on any fatig
with an intermiſſion of one pulſation in three; the poſture of ſ
ting up was more eligible than any other; he complained of gre
faintneſs, and now and then of a pain about his heart; the e
treme parts were often cold, which towards his death increa
more and more upon him, his legs and arms being mortified ſo
hours before: Upon opening the cheſt, the heart, particular
its left ventricle, was found larger than that of an ordinary
and filled with coagulated blood; the valves of the great arte

A

Fig. VI.

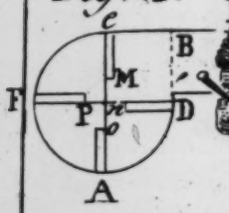


Fig. I.

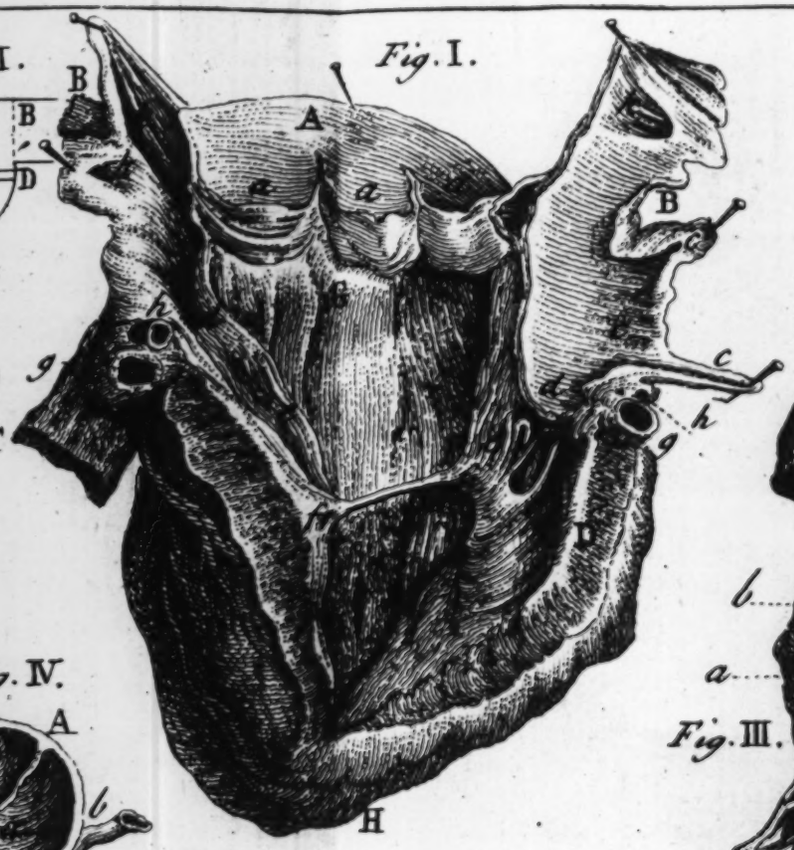


Fig. II.



Fig. XV.



Fig. IV.





Fig. III.



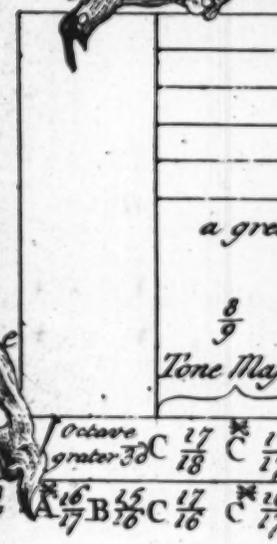
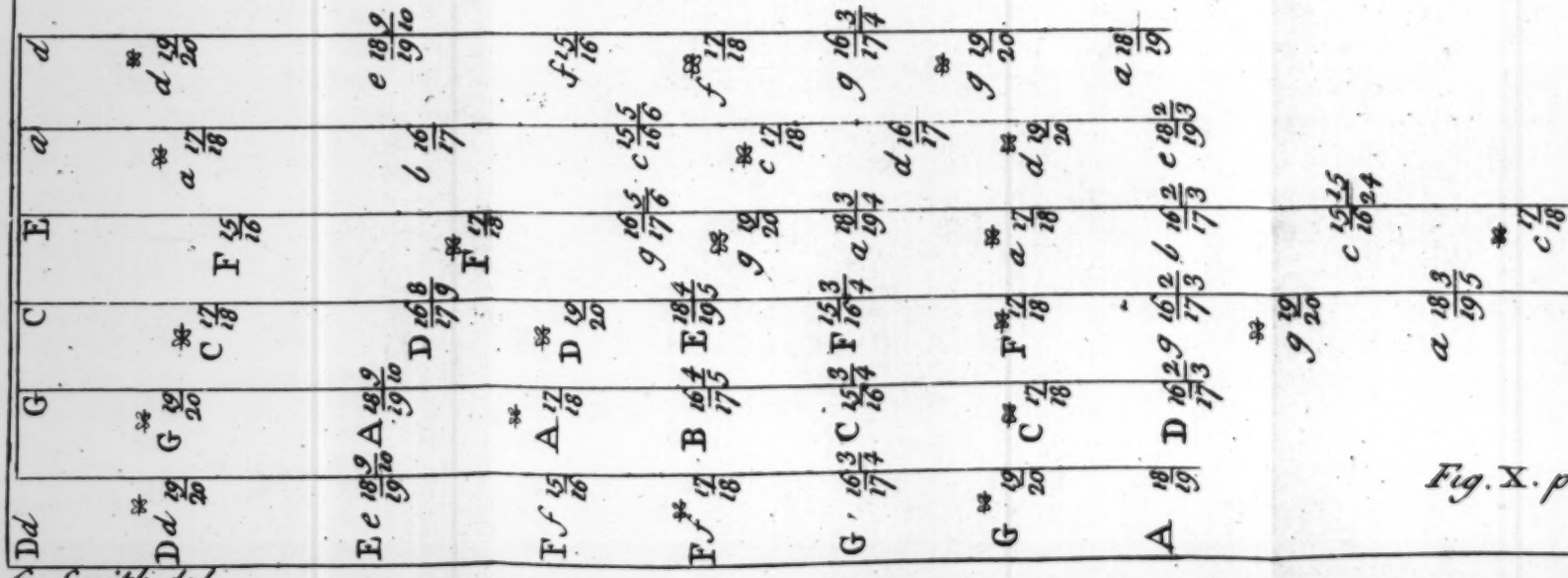


Fig. IX p. 456.



G. Smith del.

Fig. V.

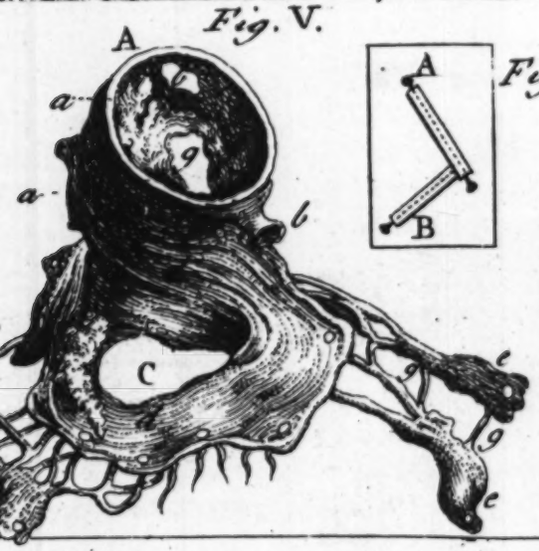


Fig. XVIII.

Fig. XIII.



Fig. VIII.

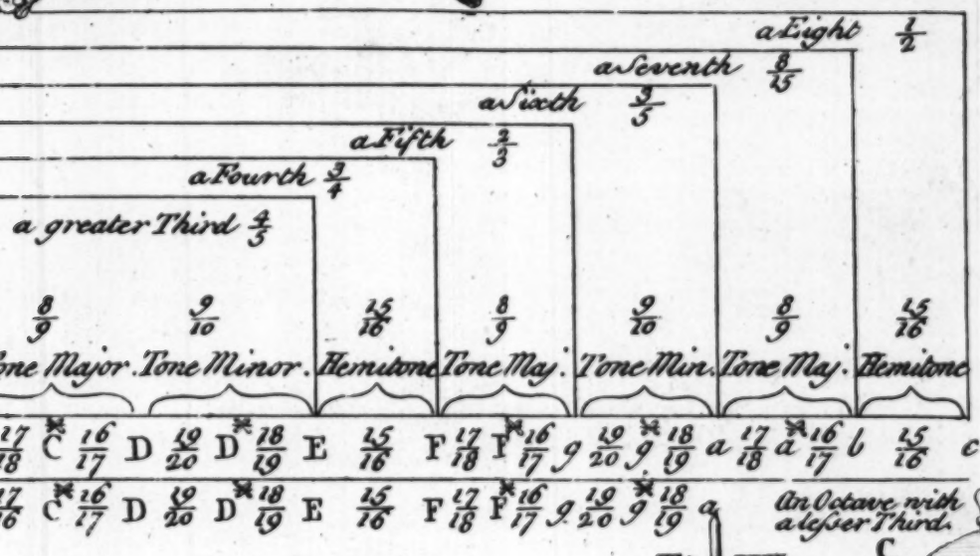


Fig. XI.

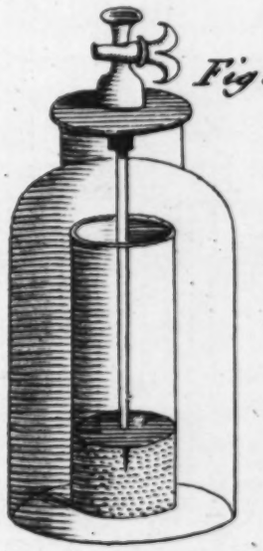


Fig. X

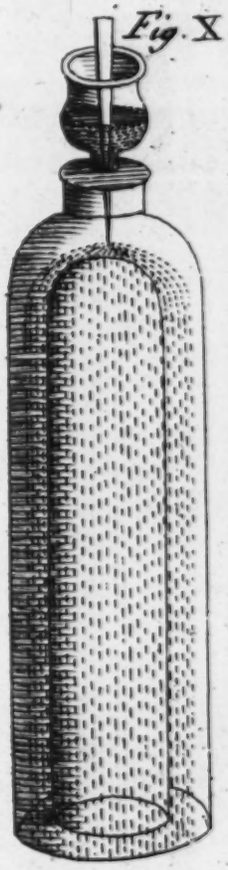


Fig. XII.

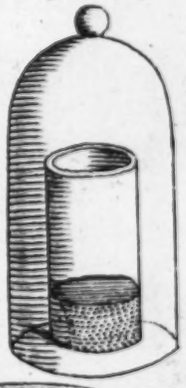


Fig. XVI.



Fig. XIV.

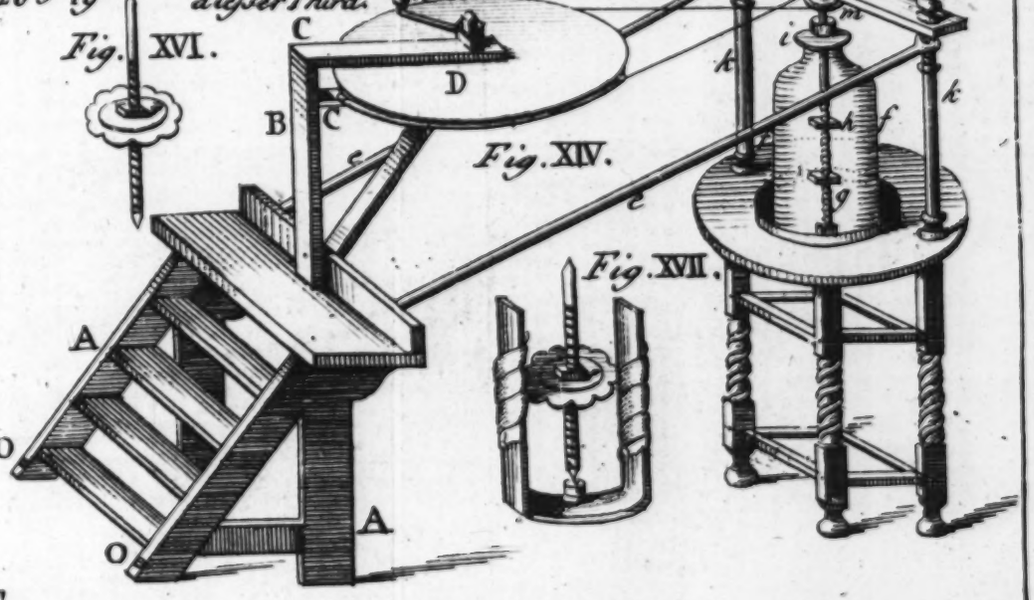
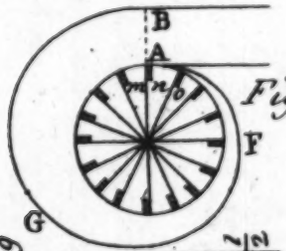
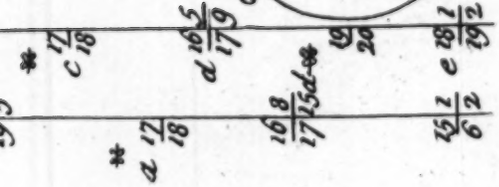


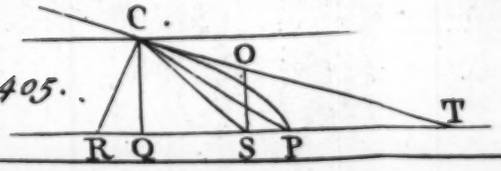
Fig. XVII.

Fig. VII.





g. X. p. 405.



Hulett Sculp

A A Fig. 1. were petrified, inſomuch, that they could not approach each other, as repreſented by Fig. 2 and 4. but an orifice ſhewn at Fig. 5. remained always open by the petrifactions *b b* Fig. 3. and *a a* Fig. 5, which had clogged theſe valves, and hindered their application to each other, as in a natural ſtate is repreſented by *a a a* Fig. 2 and 4.

The explication of the ſymptons in both theſe caſes is obvious enough, for tho' the perſon, in the firſt inſtance did not die of the ſame diſeaſe with that in the other, yet the ſymptoms in his illneſs plainly ſhewed what muſt follow, from the diſorder of theſe valves, as they are rendered more or leſs uſeleſs; for as their office is to prevent the return of the blood into the heart, in its *Diaſtole*, by exactly ſhutting up the paſſage of the *Aorta* (like the valves in water-engines) ſo, if by any accident they are hindered from performing their functions, as they were by the petrifactions mentioned; the conſequences muſt be, not only a regurgitation of blood into the heart, but they baulk its impulſive force, when the muſcular fibres in theſe valves, cannot contract to prepare the paſſage for the blood of the left ventricle, when it is to be expelled into the *Aorta*; hence, the intermiſſions of the pulſe in the firſt inſtance may be accounted for; in the latter inſtance, theſe valves were wholly uſeleſs, and the circulation became more difficult, as appeared by the refrigeration of the extreme parts, mortifications, *&c.* In both theſe caſes the left ventricle of the heart was dilated proportionably to the bad conſtitution of theſe valves, which plainly ſhews that theſe valves give ſuch aſſiſtance to the heart, as it cannot be without, and that it gradually ſuffers according to their indiſpoſition: Mr. *Cowper* had an opportunity of obſerving a like inſtance, in an elderly gentleman about 72, who ſometimes had intermiſſions in his pulſe ſeveral years before his death, in whom Mr. *Cowper* found divers petrifications in the mitral and ſemilunar valves of the left ventricle of the heart.

Fig. 1. repreſents the left ventricle of the heart opened, *&c.* A A A the inſide of the *Aorta* ſlit open to the left ventricle; B B the bulbous trunk of the *Vena pulmonalis* divided and pinned aſunder; *a a a* the three ſemilunar valves of the *Aorta*, which hinder the blood from returning to the heart; *b* a ſmall ſtony ſubſtance at the conjunction of two of the ſemilunar valves, expreſſed at Fig. *; *a a* parts of the two valves dried; *b* the petrifaction, as it appears in the dried valves; C part of the lower trunk of the *Vena Cava*, cut off immediately above the liver; *c c c* the left auricle opened and ſtretched out; D D the ſides of the left

left ventricle divided and drawn aſide, to ſhew its inſide *d d e e f f* G G; *d d* the mitral valves of the left ventricle of the heart, or *Arteria pulmonalis* divided and turned aſide; *e e* the *carneæ Columnæ*, from which ariſe the tendons faſtened to the valves *d d*, repreſented in Fig. 3. by *d f*; *f f* a tranſverſe tendon, whereby the *Columnæ carneæ* are drawn nearer each other in the *Syſtole* or contraction of the heart, when the blood is expelled into the *Aorta*; whereby, the tendons repreſented by *f f* Fig. 3 and 5. draw the mitral valve naturally; by which means, its orifice *g c* in the ſaid Fig. is not only cloſed to prevent the return of the blood by the *Vena pulmonalis*, but at the ſame time opens a paſſage for the blood of the *Arteria magna*, by withdrawing the mitral valve *d* Fig. 2. from the orifice of the *Aorta a a a g*; G G the internal ſurface of the left ventricle, where it is ſomewhat ſmoother as it leads to the *Aorta*; *g g* the trunk of the coronary vein divided, when injected with wax; *h h* the coronary artery in like manner divided; *i* one of the trunks of the *Vena pulmonalis*; *k k k* the three orifices of the trunks of the *Vena pulmonalis*, as they open into the bulbous trunk, expreſſed at B B; H the cone of the heart.

Fig. 2 A repreſents part of the *Aorta* next the heart; *a a a* the three ſemilunar valves, as they appear next the heart in a natural ſtate, whence the heart is in *Diaſtole*, and the blood hindered by theſe valves from returning to its left ventricle; *b b* part of the baſis of the heart cut off; *e e* the two *Columnæ carneæ* of the left ventricle; *d* the mitral valve; *f f* the tendons ariſing from the *Columnæ carneæ*, and inſerted into the upper and middle parts of the valve, as well as into its lower margin, which is better repreſented in the following Fig. *g* the orifice of the *Aorta* completely ſhut by the application of theſe three valves to each other.

Fig. 3. ſhews the ſame parts as in the preceeding figure, as they appeared, when the valves of the *Aorta* were petrified, excepting *a*, which repreſents a part of one of the valves that was not covered with the petrifaction; *b b b* the petrifactions on the reſt of the valves; † a ſmall petrifaction on the mitral valve; *h h h* ſome of the tranſverſe tendons, which draw the *Columnæ carneæ* to each other, when the heart is in *Syſtole*, for the more effectual cloſing the orifice of the mitral valve, repreſented here at *g*.

Fig. 4. and 5 ſhew the ſame parts repreſented in the two preceeding figures as they appear when viewed towards the heart, dried and diſplayed; A A the trunk of the *Aorta*; *a a a* Fig. 4. the

the ſemilunar valves in a natural ſtate, when the blood in the arteries preſſes them cloſe to each other; *bbbb* the trunks of the two coronary arteries cut off; *aa* Fig. 5. the ſemilunar valves petrified; *c* the orifice of the mitral valve next the *Vena pulmonalis*; *ddd* the internal ſurface of the mitral valve leading to the left ventricle; *eee* the *Columnæ carneæ*; *ff* their tendons; *gg* the tranſverſe tendons, which draw the fleſhy columns to each other when the heart is in *Syſtole*.

A dropſical Body *diſſected by Mr*, John Lafage. Phil. Tranſ. N° 299. p. 1977.

MR. *Lafage* was called to open a maiden Lady 52 years of age, who complained about ſix weeks before, of a hard ſwelling in the hypogaſtric region on the right ſide; from which time her belly grew by degrees to an exorbitant bigneſs, the great weight whereof was the moſt conſiderable ſympton, and at laſt ſuffocated the patient; the body was very much emaciated, and her legs were ſwelled a few days before her death; Mr. *Lafage* expected water, but there was only a viſcous darkiſh humour, to the quantity of 18 gallons; after the evacuation of that matter, he perceived a large heap of veſicles ariſing from a thick membrane that covered the guts, it being the *Peritonæum* ſeparated from the muſcles; he took it out, in order the better to examine thoſe veſicular bodies diſpoſed on the outer ſurface of that membrane, as alſo thoſe that were on its inſide, towards the guts; the veſicles were of different ſizes; ſome of the largeſt had been broken and ſunk, others were broken and almoſt empty, and ſome were very much diſtended and full; the matter in all of them was of the ſame nature with the extravaſated humours; what was contained in the ſmaller ones proved to be of a different colour and conſiſtence, not unlike jelly, whites of eggs, gall and honey; in ſome it was much like the humour of a true *Meliceris*: There was but little matter extravaſated in the cavity of the *Abdomen*; the greateſt part was contained betwixt the *Peritonæum* and the muſcles; the right kidney was affected with a particular dropſy; all the *Viſcera* beſides were in a natural ſtate; two *Polypus*'s were found in the heart, and two pretty large ſtones in the gall-bladder.

An

An Improvement of the Heſſian Bellows, *&c. by Mr.* Papin. Phil. Tranſ. N° 300. p. 1990.

THERE was an account of a new contrivance printed at *Leipſick in Actis Eruditorum Anno* 1699, with this title, *Rotatilis Suctor & Preſſor Heſſiacus*, which may be applied for wind, as well as for water; the ſhape of the *Tympanum* was cylindric, as repreſented by Pl. XIII. Fig. 6. where D A F C is the circumference; C P, D P, A P are the *Radii*; which bear the wings C *m*, D *n*, A *o*; C *e* is the aperture, thro' which the wind muſt be driven in the direction of the tangent C B; and it may be obſerved, that when the engine is working, every wing from the extremity of the aperture *e*, till it comes to the beginning of the ſame aperture C, always drives the ſame air, with the ſame ſwiftneſs, and at the ſame diſtance from the center; ſo that in going over all that circumference, the air finds reſiſtance by friction, and acquires nothing at all; Mr. *Papin* therefore made the circumference in a ſpiral ſhape, as A F G B in Fig. 7. the *Radii* are A P, C P, D P, *&c.* the wings are A M, C N, D O, *&c.* the aperture is A B; and it is to be obſerved, that every wing in going round drives freſh air, becauſe the air which is firſt in motion finds place to recede from the center towards the ſpiral circumference; and ſo it gives room to freſh air to come to the wing; and when the wings come near the aperture, they drive their freſh air into it without any friction; and the air which has been firſt driven and removed from the wing, cannot loſe its velocity; becauſe the wings which continually follow, do continually drive freſh air; this new ſhape of the *Heſſian* bellows alſo affords another advantage; becauſe, the air in going round, follows the ſpiral line, which is nearer to a ſtreight line, than a circular rotation; and when the air comes to the aperture, it enters it without any loſs of its ſubſtance; but in the cylindrical machine Fig. 6. the air always goes round in a circular manner, and when it comes to the aperture, the wind is driven ſtreight on in the direction of the tangent, but juſt in the beginning at C; and afterwards the impulſe is oblique, which obliquity is always increaſing till the wing comes to the point A, and muſt occaſion a great diminution of its ſtrength: Mr. *Papin* made bellows of a ſpiral figure, where the radius A P was but 10 inches and $\frac{1}{2}$, the wing A *m* two inches broad, and nine inches high; becauſe the *Tympanum* was likewiſe thus high, or a little more; the aperture A B was nine inches, or a little more, ſo

ſo as to make a ſquare hole; when Mr. *Papin* worked this engine with his foot, it made ſuch a wind as could raiſe up two pounds weight; and without doubt a ſtronger man could do much more; but this is more than ſufficient for the purpoſe, ſince there no more air need be driven than is enough for the reſpiration of ſuch as can work in the mine; and wooden pipes may eaſily be made of boards, to convey the wind to the very bottom; ſo that the air will be continually renewed within, as well as without.

Mr. *Papin* made ſome trial of the *Heſſian* bellows in a very ſtrong fire in a furnace, to melt glaſs, iron, or any other hard metal; and tho' he could open the furnace above the matter to be wrought upon, yet no flame would get out thro' the aperture, nor could the cold air from without get into the furnace; ſo that it is very likely, this will be a great conveniency for ſeveral ſorts of work, ſince men may work their materials when they are moſt ſoftened in the fire; and they may be drawn up perpendicularly, ſo as not to be bent, as they are when drawn horizontally; Mr. *Papin* believes this would be a good way, eſpecially for making with eaſe glaſs-pipes and looking-glaſſes of an extraordinary bigneſs; and he thinks that the *Heſſian* bellows may be applied to ſeveral good uſes, and ſo deſerve very much to be improved.

An Account of the Age of Manuſcripts, *the Style of Learned* Authors, Painters, Muſicians, *&c. by Mr.* Humphrey Wanley.

Phil. Tranſ. N° 300. p. 1993.

THE ſubſtance of what a moſt reverend prelate writ to Mr. *Wanley* about manuſcripts and copied writings was to the following purpoſe; viz. *that it is not only poſſible, but very eaſy, upon the peruſal of a written book, to pronounce in what age or century it was writ, ſuppoſing a man to be tolerably well verſed in books of that language or country; and that this judgment may be made, only by obſerving the ſhape and figure of the letters of the book, which (like all other things) have their fixed periods of duration; as being formed one way in ſuch a century, and another way in the next; time only (which alters the outward ſtate of other things) working this change alſo in letters, of what age, language, or country ſoever they be*: And then as to the original compoſitions; *that the ſtyle or diction of any noted author being well obſerved, it is very eaſy to diſcover ſuch others of his works, as have gone abroad, without his name; and alſo the very time when the author lived*: Mr. *Wanley* acknowledges that it is evident, a perſon may judge of ſome

MSS. by the hand; and of the genuine and ſpurious works of ſome authors; and likewiſe, of the time wherein they lived, by their ſtyle; but whether this be ſo eaſy a work, and that the rules men generally go by in theſe caſes, are always infallible guides, is what Mr. *Wanley* very much doubts of; ſuppoſing for inſtance, a man ſhould bring to any antiquary a good MS. copy of the *Hebrew* bible, pentateuch or pſalter, written in a ſmall common letter, without points, fine knots, flouriſhes, pictures, or large letters, or any thing that would look pompous; and ſuppoſing that the ink, parchment, *&c.* ſhould carry a ſeeming face of antiquity with them, and that a man ſhould ſay his MS. was 1000, 1200, or 1300 years old, when really it was written within a very few years; could the antiquary from the hand alone ſoon find out the cheat? All the *Hebrew* MSS. Mr. *Wanley* had ſeen, were writ either in *Samaritan* or *Chaldee* letters; as to the *Samaritan*, he owns, they bear a good reſemblance to each other; and that they differ very much from thoſe *Samaritan* characters, which we find ſtamped upon divers truly ancient and genuine coins; but then there ſeems to be ſuch a reſemblance, as to the character, between thoſe coins ſtruck in ages far diſtant from each other, that it is hard (from the conſideration of the metal, its fabric, weight, or from the ſhape of the letters in the inſcription, *&c.*) to ſay, which coin was made in the time of *David*, or *Solomon*, and which no older than the time of the *Maccabees*; this being rather to be gathered from the words, and meaning of the inſcriptions, than from the figure of the characters which compoſe them; the ſame may be ſaid in a great meaſure, of the old *Greek*, *Punic*, *Roman*, *Britiſh* and other coins: The *Chaldee* character has indeed, varied in tract of time, according to the different fancies and humours of men; the *even plain* letter, he thinks, is the moſt ancient; this they altered into a more neat way of making it, as in *R. Stephens Hebrew* bibles; there is a third faſhion, of waving the perpendicular ſtrokes like rays, as in ſome of the *Hebrew* coins exhibited in the *Prolegomena* to the *Polyglot* bibles; then fourthly, there is a large fat letter in the MS. rituals and liturgies, beſides the *Rabbinical* letters of *Italy* and *Germany*, with their offſpring, the *Literæ coronatæ*, and perhaps others he never ſaw; not to mention here the *Jewiſh* cuſtom of writing the vulgar languages of the country, wherein they live, in *Hebrew* letters: It ſeems a hard matter, to trace the original and progreſs of all theſe ways of writing, ſo as upon the bare ſight of a MS. written in the *Hebrew* language or character, to ſay, *by the ſhape of*

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the letters of this book it appears to be ſo old; and it ſeems much more difficult to aſſign the particular province or country, wherein each *Hebrew* book was written; as for inſtance, in *Italy*, *France*, *Spain*, *Portugal*, *England*, *Holland*, *Germany*, *Poland*, *Barbary*, *Perſia*, *India*, in the ſeveral provinces of *Turkey*, *&c.* The ſame almoſt may be ſaid of the *Greek* manuſcripts, in which language there has been a great diverſity of writing, according to the different humours of the ſcribes, the faſhion then in uſe, or the manner of that particular province, in which ſuch a book was written; nor is it eaſy (tho' a perſon would be apt to take ſuch differences for ſo many land-marks) to tell the age of a *Greek* M S. without the date; and Mr. *Wanley* never ſaw ſuch a date ſo high as the year 6400, according to the *Greek* computation; and it is ſtill much harder, from any remarks about the character, illumination, ink, parchment, paper, binding, *&c.* to find out what country, province, or iſland, ſuch a *Greek* book ſhould be written in, or what countryman the ſcribe ſhould be; for if a man is born in one country, and writes a book in another, ſtill retaining the character and manner of writing uſed in his own country, Mr. *Wanley* looks upon it to be the ſame thing, as if he wrote it at home; and therefore, he looks upon the *Greek* M S S. which *Angelus Borgecius* wrote at *Paris*, as if they were written in *Candy*, where he was born; and ſo amongſt ſeveral others, to inſtance in a *Latin* M S. he looks upon a copy of pope *Gregory*'s paſtoral care (now in the *Bodleian* library) as a noble monument of our *Saxon* anceſtors; tho' St. *Willibald* wrote it, perhaps at mount *Caſſinum* in *Italy*; and afterwards, as it is probable, carried it with him into *Germany*, where it remained at *Wurtzburg*, till that city was plundered by the *Swedes* about 70 years ago: Mr. *Wanley* by exactly obſerving the nature of the characters, *&c.* of thoſe *Latin* M S S. (whereof there is a greater plenty than of any others, and conſequently may in ſome meaſure remove this difficulty) whoſe country he was ſure of, has afterwards been enabled to ſay, that this book looks, as if it had been written in *France*, *Italy*, *Spain*, *Germany*, the *Netherlands*, *England*, *Ireland*, &c. *and*, it may be, *about ſuch a time*: What further adds to the difficulty is, that it is known, that the ſhape of the majuſcule letters found in *Greek* M S S. has been retained, for above 600 years together, with little variation; and alſo that ſome M S S. written in minuſcles, and with accents, are older than ſome others which are without them; and likewiſe that the preſent *Greek* copiſts or *Librarii* have three or four different hands,

commonly uſed by them, one being their common hand, the others an imitation of old MSS. which are more beautiful (but troubleſome and coſtly in writing) than their ordinary running hands; and thus Mr. *Wanley* has ſeen ſome very new things written in the ſame hand with books, which were certainly 400 years old.

What methods learned men have taken in order to inform themſelves of the different ages of MSS. Mr. *Wanley* does not know, but his manner has been this; *viz.* he has been careful to get all the dates he could, wherein it was ſaid, that ſuch an individual MS. was written, at *ſuch a time*, or by *ſuch a particular perſon*; every book with a date, being as a ſtandard, whereby to know the age of thoſe books of the ſame or a like hand, and of thoſe that are not very much older or newer; where dates have been wanting in ſome books, perhaps, they have had ſome ſucceſſion of emperors, kings, popes, biſhops, or other officers; and ſetting down the continuance of their predeceſſors for ſo many years, months and days, if there be only the bare name of him, who was the laſt in order (all other circumſtances concurring) he then judges the book to have been written during the life or reign of ſuch a perſon; eſpecially, if that ſucceſſion be afterwards continued by a more recent hand, or that there be two ſuch ſucceſſions, as of kings and biſhops, and the laſt of each happen to be cotemporaries; Mr. *Wanley* has made other obſervations from hiſtorical notes and eccleſiaſtical tables in ſome books; at other times one may light upon ſome authentic charter or original writing, in the ſame hand with ſuch a book, as he has remembered to have formerly ſeen, but without any gueſs at the age of it; the age of the charter being known, that of the book is then alſo known; ſo that Mr. *Wanley* never entertains any notion or relies upon any obſervation, but as he finds it confirmed by the ſuffrage of concurring circumſtances and ſufficient authority; but even in ſome dates, he has found that they have been altered by later hands, for corrupt and baſe ends; ſome are ſo worded, that when a perſon takes the time they mention, to be the time when the MS. was finiſhed by the copiſt, or book-writer, it is meant only of the time, when the author finiſhed his compoſition; other books are poſt-dated, that they might be accounted new; of this laſt kind, is a *Greek* MS. Mr. *Wanley* ſaw in the univerſity-library at *Cambridge*, which as appears by a written annotation therein, was bought ſuch a year at *Rome*, for ſo much; and yet the date pretends, that the book was written at *Rome* in ſuch a year, which happens to be two years after it was bought

bought and paid for; the reaſon of theſe poſt-dates was, becauſe, before printing was invented, a book by how much the newer, was by ſo much the more valuable; and therefore, Mr. *Wanley* has found, in ſome catalogues of the M S S. formerly extant in our abbey-libraries, that when they ſaid ſuch a book was *Liber vetus*, they would often add *& inutilis*; but *Liber novus* was *nitidus*, *eleganter ſcriptus*, *lectu facilis*, &c. which mean opinion of the ancient copies, by the bye, may have been the occaſion of the loſs of many a good author: The *Librarii* or book-writers, were from the time of the *Romans* a particular company of men, and their buſineſs was a trade; but tho' book-writing was their profeſſion, yet they had afterwards but ½ part of the buſineſs: Learning, after the erection of monaſteries was chiefly in the hands of the clergy; and they were for the moſt part Regulars, and lived in monaſteries; amongſt theſe, there were always ſeveral induſtrious men, who continually wrote new copies of old books, either for their own uſe, for the monaſtery, or for both, which ſeems to have ſwallowed up above half the buſineſs; then, if an extraordinary book was to be written, for the ſtanding, and more particular uſe of the church or monaſtery, the antiquary muſt be ſent for, to write it in large characters, after the old manner, and ſuch a copy they knew would laſt for ſeveral ages, without renovation; between theſe two ſorts of people, the writing-monks and antiquaries, the poor *Librarii* or common writers who had families to maintain, could hardly earn their bread; this put them upon a quicker diſpatch, that ſo they might under-ſell each other; in order to which, they would employ ſeveral perſons at one time, in writing the ſame book (each perſon, excepting him who wrote the firſt ſkin, beginning where his fellow was to leave off) or elſe, they would form the letters ſmaller and leaner, and make uſe of more ligatures and abbreviations than uſually others did; and this is the only account, Mr. *Wanley* can give, for that variety of hands, which in former ages, being learned of or borrowed from the *Romans*, was commonly uſed, and in faſhion at the ſame time, and in the ſame country, throughout theſe weſtern parts of *Europe*; and for their becoming leſs and leſs for one age after another, an inſtance of this may be given from the hands in *England*, which about the year of Our Lord 730 were of three ſorts. 1. The *Roman* capitals, ſtill retained and kept up by the antiquaries, in ſome books and charters. 2. The more ſet *Saxon* letters (which have a near affinity with the more ancient *Iriſh* characters, as being with them derived from the *Roman*) which were uſed as the common hand of the age, by the

the monks in their books, and ſome charters of their dictating and writing. 3. The running *Saxon* letters, fuller of abbreviations, and ſomewhat a-kin to the *Longobardic* and *Francogallic* (both which, with this third ſort, were alſo of *Roman* original) were uſed by theſe *Librarii* in their books and charters; as alſo by ſome authors, who wrote much, as *Bede*, &c. There was another ſort of book-writers ſtill in vogue; namely, the *Notarii*, whoſe buſineſs it was to take trials and pleadings in courts of judicature; to write as *Amanuenſes* from the mouth of an author; and to take homilies and ſermons at church, from the mouth of the preacher; theſe *Notarii* made uſe of *Notæ* or marks, inſtead of letters; but when in proceſs of time, letters were uſually written ſmall and quick, and abbreviations became common, the *Notarii* were diſcarded unleſs they would write books in long-hand, as other *Librarii* did, and their *Notæ* grew out of uſe, and moſt of their performances in notes or marks have ſince been deſtroyed: Suppoſing then, that a man had one *Latin* book of each of the four ſorts abovementioned laid before him, written all at a time, and without any date or note of the age; would not he be ready to ſay, that the three firſt were older than the other? As that the book in capitals, was older, than that in the middling hand; and this again older than that in the running and ſmaller hand? And that ſuch a book written with the *Notæ*, being all full of marks was not *Latin*, but of ſome other unknown language? But to come down later; ſuppoſing, that a perſon ſhould have ſome more recent books or charters laid before him, in the pipe, text, exchequer, chancery, court, and common hands, all written at the ſame time, would not he be apt to ſay, that one ſeemed to him to be older than the other, and that they were the hands of ſeveral nations? If it be difficult for an inquiſitive perſon to be a perfect maſter in all the ſucceſſions of hands, that have been uſed in his own country, ſo far as he may be guided by the monuments extant therein (and Mr. *Wanley* never heard of any man that was ſuch a maſter) ſurely it muſt be more difficult to pronounce from the hand, the age of thoſe books, which were written in other countries, in an unknown language; and what may make a man ſtill more liable to miſtakes (beſides the want of dates in the moſt ancient *Greek*, *Latin* and other MSS.) is the practice of ſeveral writers, ſtill to uſe the very ſame hand, when in years, which they learned when they were young; like ſeveral old perſons, who ſtill continue to write *Roman* and ſecretary hands, which were more faſhionable 50 or 60 years ago, than now.

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As to the great eaſineſs of finding out an author, and the time he lived in, by his ſtyle and phraſe; Mr. *Wanley* obſerves, that people have learned the knack of changing their ſtyle upon occaſion, ſo artificially, as not to be diſcovered, but when they themſelves have a mind to be known: Who would have thought that *Eraſmus* wrote the *Epiſtolæ obſcurorum Virorum?* Or, that ſome of the nicer, nay, the moſt eminent modern critics could have been impoſed upon by their familiar and near acquaintance, who trumped upon them their own recent performances for invaluable fragments of the ancients, whoſe other works, theſe very criticks had lying before them? It has been a frequent practice in all ages for poor ſcribblers to father their wretched offſpring upon illuſtrious perſons; and the diſparity between the genuine works of the one, and the ſpurious pieces of the other being evident enough, it has been eaſy to diſtinguiſh between the gold and the braſs; but Mr. *Wanley* would aſk the queſtion, is all that is now aſcribed by learned men to ſome ancient voluminous *Greek* and *Latin* authors, undoubtedly theirs? May there not ſtill ſome ſuppoſititious pieces lurk amongſt them, which may have had the luck to be received, only becauſe they have been more ingeniouſly counterfeited? Nay, may not the ſame perſon in the courſe of his life, even alter and vary his ſtyle and phraſe unwittingly, and without any deſign to do ſo? Mr. *Richardſon* in his anſwer to *Amyntor*, upon occaſion of the difference in point of ſtyle between the revelation of St. *John* and his other works, between the prophecy of *Jeremiah* and his *Lamentations*, tells us, from Dr. *Cave*, that the conſideration of the times when a man writes, or of the perſons to whom, or the ſubjects about which, or the temper of body, or the humour he is in when he writes, or the care and pains that he takes in writing, may occaſion ſuch alterations in his ſtyle, as that no certain rule can be inferred from thence; and if it was really poſſible to find out the time when an author lived, only by diligently reading his works, ſurely, Mr. *Wanley* thinks, the world would have been long ſince agreed, as to the time when *Homer* lived, tho' they could not tell where he was born; and he believes, that in the liſt of eccleſiaſtical Writers there are ſome, and thoſe not of the leaſt conſideration, who (notwithſtanding their works have been read over and over) are ſtill reckoned to be of an uncertain age.

As for pictures Mr. *Wanley* owns, that the works of ſeveral maſters may be known by the hands, tho' they may be almoſt as different as their ſeveral hand writings; but, that one painter cannot copy from another ſo exactly, as that in tract of time it

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ſhall not be known which picture is the original, is what Mr. *Wanley* will not aſſert: It has been frequently practiſed by painters to borrow pictures of thoſe who are lovers and judges of ſuch things, to copy them, and to return their copies for the originals, without any diſcovery made by the owners; and he believes it poſſible, tho'exceeding difficult, for a great maſter to copy a picture in ſuch a manner, that when they both ſtand together, a good judge ſhall not be able poſitively to ſay, which is the copy and which not; nor can he that drew the original ſay, that he could imitate his own handy-work better than a ſtranger has done; and yet one would not think it much more difficult, for a man to imitate a drawing or picture, than to counterfeit another man's hand-writing, which ſome people can do very exactly; and others can with pen and ink ſo nicely copy after any thing that is printed, that a perſon would affirm their writing to have been printed off at preſs: As to the notion of diſcerning the age, as well as the hand of the painter by his picture, Mr. *Wanley* does not doubt, but that there is a great deal in it; and why, might not this notion be advanced a little farther, and the painter's complexion be known by his pictures, as well as his age? As ſuppoſing, that the ſanguine naturally run upon portraits, poetical hiſtories, nudities, *&c.* the choleric upon battle-pieces, ſea-fights fire-pieces, by land or ſea, tempeſts, *&c.* the phlegmatic upon the ſtill-life, flower-pieces, birds, beaſts, fiſhes, *&c.* and the melancholic upon landſkips, architecture, pieces of perſpective, not but that the different genius of a country, or the deſire of a good cuſtomer, may oblige a painter to work upon a ſubject, which he has no great fancy for: As to the difference in the works of painters, grown old, in reſpect of what they did when young, Mr. *Wanley* queſtions, whether any certain rules can be eſtabliſh'd as to their performances in that kind; but, as painters are generally known to live faſter than other men, which may at length occaſion a failure in their ſight and memory, a trepidation in their hands, *&c.* yet Mr. *Wanley* never heard, that *Michael Angelo*, *Albertus Durer*, *Titian* and others, painted worſe at the latter end of their long lives, than they did before; nay Signior *Vario*, tho' grown old, paints far better than ever, and is almoſt aſhamed of ſome of his own works, which he painted at *Windſor* caſtle, in the time of King *Charles* II; there may be this in it, that aged perſons having attained, thro' long practice, to a greater experience, to a more ſolid and mature judgment, than they had when younger, are more cautious of what they let go out of their hands, and correct thoſe flaſhy touches of their pencils,

cils, and other ſuperfluous irregularities, which they and others were formerly very fond of; as for the flame and motion of the eyes in a picture, or the breath in its mouth, Mr. *Wanley* can ſay but little; as to the painters painting a living or moving thing, ſo that one ſhall almoſt diſcern the motion, and ſee the bird flying, the horſe, or hound running, *&c.* that is more eaſy; eſpecially, when aſſiſted with the friendly and pregnant fancy of the pleaſed ſpectator: In ſtill-life, indeed, the eye is quickly deceived, and tho' there are ſeveral maſters living more excellent at it, than ever *Zeuxis* and *Pharrhaſius* were; yet ſtill with all their art, it is very difficult to impoſe upon a man, ſo as to make him believe, that it is not a picture, but the very life he ſees before him.

Muſicians ſeem to be under the ſame predicament with painters, ſince they are obſerved to live faſt, as alſo the poets; it is by the practice of ſeveral years, that they attain to a juſt knowledge and maſtery in their reſpective arts; and as their firſt compoſitions are little and light, ſuitable to the mercurial temper of heedleſs and inconſtant youth; ſo in time this wears off, and as their experience and judgment increaſes, their compoſitions grow more ſolid and ſound; a young man may make a better minuet or jigg, but the elder a more ſound ſervice or anthem: If it ſhould be ſaid, that the very beſt painters, muſicians, and poets, died young, or at leaſt, before they attained to an advanced age, when they would have failed, or grown dull, as others did; Mr. *Wanley* begs leave to ſay, that old men are of two ſorts, either thoſe who are much affected with their age, and weakened, or thoſe who are not; if a man is born of unſound parents, or has lived all along in an air diſagreeable to his conſtitution, or is always unhealthful, or lived an intemperate or debauched life, or has been cruſhed by any heavy misfortunes, or always lived in poverty or diſcontent; it is no wonder, if, in ſpite of all this, he attains to old age; but then, he will probably loſe the clearneſs of his head, the fix'd attention of his mind, the brightneſs of his parts, which he might formerly be noted for; if a man has never had any of thoſe diſadvantages to wreſtle with, but has all along been bleſſed with the contrary, then he being bred up to a profeſſion, and always following it, his judgment therein ſtill increaſes, and his hand (a perſon would think) ſhould be more nimble and ready, and the man a better painter, muſician, or orator, than ever; and why not a better poet too? For if Mr. *Dryden* (tho' he was ſaid to have been unhealthy at laſt) would have taken as much pains, or had been allowed time to reviſe his latter poems, as in ſome of his former, they might have been as well, if not better

received; ſo that Mr. *Wanley* does not ſee, that it is old age that does a man this diſ-kindneſs, but rather that it is the accidents that do too often attend it, which yet many are free from to the laſt: Suppoſing then, that *Raphael*, or *Vandyke*, or Mr. *Purcel*, or *Aleſſandro Stradella* ſhould have continued their practice of painting and muſic, till they had grown old; from the accidents attending which, ſuppoſe them (as a great many other people to be very free, might we not then have juſtly expected from them, even greater wonders than they had ever before performed? Mr. *Wanley* will nor ſay, that an old general is fitter to be truſted than a young one, or that mareſchal *Schomberg* at his death, was a better ſoldier, notwithſtanding his age, than the preſent kings of *Sweden* and *Poland*; but rather that the ſtudy of divinity, or of the laws, does ſeem as nice and copious, as that of painting and muſic; now, the old and ſage men of theſe profeſſions, are every where moſt regarded, they are found to have the ripeſt judgments, and they are deſervedly imployed in the moſt weighty affairs appertaining to their profeſſions; it has alſo been ſeen (as was partly ſaid before) that ſome painters and muſicians have not at all failed as they grew old, but kept that great reputation to the laſt, which they had before acquired.

Upon the whole, it ſeems to Mr. *Wanley*, that there is a gradual and ſenſible alteration in the appearence of things, and eſpecially in the *ſcripture*, or hand-writing of M S S. now theſe ought to be conſidered with reſpect to the particular places, wherein they were written; every country is ſuppoſed to have remaining therein the greateſt variety, and moſt conſiderable monuments of its own characters; unleſs they are known to have been carried away to other places; and therefore, if any man is deſirous of conſidering the letters of any language, that has been confined to any particular region or province, it is but going thither; and it is ten to one, but, if he is diligent, he may ſatisfy his curioſity very well; for inſtance, ſuppoſing a perſon ſhould be willing to conſider the nature of the *Iriſh* letters, their original, progreſs, and variations, with their relation to the *Roman*, *Franco*, and *Anglo-Saxon*; this might be done chiefly, by travelling to *Ireland*, by taking a trip into the highlands of *Scotland*, and perhaps into the *Iſle of Man*, and by conſulting ſome *Engliſh*, and other libraries, whither ſome *Iriſh* M S S. have been carried; and ſuppoſing a perſon ſhould conſider the *French*, *Italian*, *Spaniſh*, or *Engliſh* hands, each country affords ſufficient helps; but if a man would conſider the letters of a dead or living language, which ſpread far, and has been, or is ſtill uſed

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in ſeveral countries, he cannot be ſuppoſed a perfect maſter in all the ways of writing that language, till he has conſidered the whole ſtage and ſucceſſion of its letters in each of thoſe countries; amongſt thoſe languages, Mr. *Wanley* reckons the *Hebrew*, *Arabic*, *Turkiſh*, *Armenian*, *Perſian*, *Greek*, *Latin*, *Teutonic*, *Sclavonian*, &c. and tho' *Latin* is common amongſt us, and every body is ready to pronounce the age of a *Latin* M S. yet Mr. *Wanley* thinks they would do well to enquire where, as well as when a book was written; and if they are certain, that ſuch a *Latin* book was written in ſuch a particular country or province, it is then more eaſy, by conſidering the ſucceſſion of letters uſed in that province, or by comparing it with other books written therein, to ſay how old it is; for want of this conſideration, ſeveral learned perſons have been almoſt always out in their calculations, and have pronounced at random; if then this method appears rational, and even neceſſary, in order to attain to a ſufficient meaſure of this ſort of knowledge; it follows, that it is no eaſy matter to aſſign the age, even of a *Latin* M S. no not even in *England*, where yet he ſuppoſes, that there may be as great a variety of *Latin* hands, as in moſt other countries.

As for painting and muſic, Mr. *Wanley* knows very well, that each painter's hand, and each muſician's manner differs from another; but whether there is a gradual and remarkable variation from themſelves, in the courſe of their lives, is what he never heard aſſerted; this is certain, that they can change their way of painting and compoſing at pleaſure; and therefore, Mr. *Purcel's Dulcibella* is ſaid not to be like his other muſic; and Mr. *Fuller* the painter could put one of his pieces upon Sir *Peter Lilly*, for a moſt incomparable picture of *Michael Angelo*; but then, theſe changes and variations from their uſual manner are very ſeldom made; and a man generally purſues and practiſes that which is moſt agreeable to his own genius; for this reaſon, when a painter's hand is fixed, his manner is then limited; and ſo when a curious perſon comes into a gallery, he knows that this picture was done by *Ryley*, *Kneller*, *Vandyke*, *Dobſon*, *Tintoret*, &c. and that to be a copy after *Reubens*, *Georgeon*, *Salv. Roſa*, *Han. Caraccio*, *Pietro di Cortona*, &c. and when he comes to an *Opera*, to a *Conſort*, or to *Church*, not knowing before hand, what muſic is to be performed, yet he may ſoon diſcern, that it was compoſed by *Corelli*, *Baptiſt*, *Baſſani*, *Chariſſimi*, *Blow*, *Purcel*, &c. and ſo upon reading an ancient author, a ſagacious and learned perſon may find, that he writes, according to the manner of ſuch an age, that the ſtile imitates ſuch another, or that

the book, tho' it bears ſuch an author's name, yet might perhaps be more truly aſcribed to another, with whoſe ſtile it more exactly agrees; as for inſtance, that piece of St. *Cyril*'s, publiſhed from the *Eſcurial* MS. by *Barthaſar Corderius*, is thought, by is ſon of the analogy in point of ſtile, to be *Origen*'s; but then, whether all this can be always done, done eaſily, and without error, is the queſtion; and it ſeems ſtill a greater difficulty, certainly, t o diſcover how old the painter, muſician, poet, orator, or other author was, when he finiſhed any one piece of his works, unleſs a man is plainly told ſo; this being a ſort of knowledge, that thoſe who have been otherwiſe ſufficiently experienced in their ſeveral arts and profeſſions, have not as yet pretended to.

A Perſon deceaſed of a Schirrous Tumour *in his Breaſt, by Mr.* Thomas Greenhill. Phil. Tranſ. N°. 300. p. 2009.

MR. *I. D.* was ſuppoſed to have died of a conſumption; foraſmuch, as 14 months before, he had been violently ſeiſed with an inflammation of his lungs, accompanied with a ſharp fever, difficulty of breathing, cough, acute ſtitches, and pleuretic pains, with a ſpitting of blood, *&c.* He was bled largely in the beginning, which was often repeated during his ſickneſs; and he continually took ſuch proper medicines as were preſcribed him; but notwithſtanding, about *Eaſter*, there appeared a tumour on the breaſt-bone, pap, and pectoral muſcle of the left-ſide, with a fullneſs under the *Axilla*; from whence it was conjectured, a collection of purulent matter in the cavity of the *Thorax*, and that the *Sternum* was foul; the firſt, from the aforeſaid tumours, and from his ſpitting a bloody and purulent matter; and the latter, from the riſing and inequality of that part; but, upon Mr. *Greenhill*'s opening him, he found his caſe very different, and ſurpriſing; for, as ſoon as he had divided and removed the common integuments of the *Thorax*, he found, inſtead of a riſing of the bone with cariofity, only an oblong tumour, about four fingers in length, two in breadth, and of a proportionable thickneſs, weighing about three ounces; it extended itſelf perpendicularly on the ſuperficies of that part of the *Sternum*, which joins with the *Cartilago enſiformis*; he ſeparated it eaſily with a knife, from the breaſt-bone, and he found it to be of that ſort of wens, or incyſted tumours called *Atheroma*, containing a pappy ſubſtance, like ſodden barley; next appeared a very large tumour on the left-ſide of the *Thorax*, covering the whole pap and pectoral muſcles forwards, with a fullneſs under the *Axilla* of the ſame arm; then opening the *Thorax*, he found

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the ſame tumour, comprehending the intercoſtals, *Deltoides*, ſubclavian, and ſubſclapulary muſcles, and the whole axillary and mammillary glands, which being obſtructed, and its veſſels replete with a creamy pappy matter, thicker and whiter than the former; there was produced ſuch an induration of the aforeſaid glands and muſcles, which compoſe the upper part of the breaſt, that it may be more properly reckoned a ſchirrous tumour, which was on the outſide of the breaſt, ſomewhat bigger than one's hand, extending itſelf from the clavicle to the lower part of the pap, and laterally from the baſis of the muſcle quite under the arm-pit; internally, it poſſeſſed a third part of the cavity of the breaſt, crouding the left lobe of the lungs to the right-ſide, and in its upper part firmly growing to it, which it likewiſe did every way to the intercoſtal muſcles; it was about the bigneſs of a penny-loaf; and the whole tumour being conſidered together, it might reaſonably be allowed to weigh between three and four pounds, which being cut in two, there ouzed out of it, as out of a ſqueezed ſponge, a great quantity of thick, white, and pappy matter; and what is more particularly remarkable, there was formed a large ſink or *Pelvis* in the middle of the axillary gland, which contained a thinner diſcoloured matter, and had a free communication to the veſſels of the lungs, in the upper part of it, where it was united; and from hence it was, that the patient generally found eaſe, when he had ſomewhat emptied it by large expectorations, and that he could ſo exactly perceive when any thin rheum or matter flowed to the part; and it was here only that the lungs were black and replete with ſtagnated blood, and ſome globules of the aforeſaid matter in its *Veſiculæ*; the reſt of the lungs was pretty clear from any ulcers or matter, but they were of a ſublivid colour, and ſtrictly adhered on both ſides to the *Pleura*, but particularly on the left-ſide, all about the ſchirrous tumour; the *Veſica Fellis*, or gall-bladder, was full of ſtones, of the bigneſs of a runcival pea, and conſiſted moſtly of odd angles, and were formed of a thick viſcous ſediment of gall, (which was found therein) from an obſtruction of its veſſels, or jaundice, which the patient had had ſome years before; they were 22 in number, ſome triangular, others quadrangular, ſome quincuncial, *&c.* there was nothing elſe remarkable, beſides a *Maraſmus* of the external parts, the waſting of the caul, and an emptineſs of all the *Viſcera*, and blood-veſſels in general.

A Pin *found in the* Gizzard *of a* Fowl; *by Mr.* Regnart. Phil. Tranſ. N° 301. p. 2055.

MR *Regnart*, in cutting the ſtomach or gizzard of a fowl found ſomething that reſiſted his knife, and upon examining it further, he diſcover'd it to be a pin, which the pullet had ſwallowed, and in all probability had lain there for ſome time; for it had pierced thro' the membrane on the inſide, and made a paſſage into the thick part, where it had form'd itſelf a bed; it is obſervable, that the head of the pin had paſs'd thro' the firſt ſhrivell'd membrane, but ſtopp'd at the ſecond, which ſeem'd more thick and nervous; ſo that the head remain'd incloſ'd between the two membranes, and the body had made its way into the fleſhy muſcular part; at the point there was form'd a *Callus*, of the bigneſs of a ſmall pea, which ſeem'd to be a defence, that nature had form'd to oppoſe it, as it was working itſelf farther: It is not in the leaſt ſurpriſing, that a pin ſhould lie in the fleſhy parts, ſince we ſee, that a muſket-ball will lie there a conſiderable time, without injuring the Part much; but, how it ſhould paſs thro' the membranes of the ſtomach, without obſtructing its functions, and the pullet thrive well after it, Mr. *Regnart* leaves others to determine.

The Theory *of* Muſic *reduc'd to Arithmetical and Geometrical Proportions, by Mr.* Salmon. Phil. Tranſ. N° 302, p. 2094.

MR *Salmon*, made a muſical experiment, which was founded upon the following propoſitions; *viz.* That muſic conſiſted in proportions; and the more exact the proportions are, the better the muſic; that his proportions are the ſame that the ancient *Greeks* uſed; that the ſeries of notes and half-notes is the ſame our modern muſic aims at, which Mr. *Salmon* in his experiment exhibited upon finger-boards, calculated in mathematical proportions; this was demonſtrated upon a Viol, becauſe, the ſtrings were of the greateſt length, and proportions more eaſily diſcern'd; but it may be accommodated to any inſtrument, by ſuch mechanical contrivances, as ſhall render ſuch ſounds, as the muſic requires.

To prove the foregoing propoſitions; two viols were mathemachically ſet out, with a particular fret, for each ſtring, that each ſtop might be perfectly exact; upon theſe a *Sonata* was perform'd, by thoſe two eminent violiſts, Mr. *Frederick* and Mr. *Chriſtian Stefkins*; whereby it appear'd, that the theory was certain

tain, ſince all the ſtops were acknowledged by them, to be perfect; and that they might be prov'd agreeable to what the beſt ear and the beſt hand performs in modern practice, the famous *Italian* Signior *Gaſpereni* play'd another *Sonata* upon the violin in concert with them, wherein the moſt compleat harmony was heard: The full knowledge and proof of this experiment may be found in Plate XIII. Fig. 8. 9. wherein muſic is ſet forth, firſt, arithmetically, and then geometrically; the mathematician may, by computing the proportions, be ſatisfied, that the five ſorts of half notes here ſet down, exactly conſtitute all thoſe intervals, of which our muſic conſiſts; and afterwards, he may ſee them ſet forth upon a monochord, where the meaſure of all the notes and half-notes comes exactly to the middle of the ſtring; the Learn'd will find, that theſe are the very proportions which the old *Greek* authors have left us in their writings, and the practical muſician teſtify, that theſe are the beſt notes he ever heard.

Fig. 8. between the two loweſt lines, you have the ſeries of all the 12 half notes in an octave, from *A-re*, to *A la-mi-re*, which added together make an octave or exact duple proportion; the ſeveral parts being alſo added together, make all thoſe intervals, whereof it conſiſts; as for example, the two half notes from A to A ♯ $\frac{17}{18}$, and from A ♯ to B $\frac{16}{17}$ make a major tone $\frac{8}{9}$, to which if an hemi-tone from B to C $\frac{15}{16}$ be added, you have a leſſer third $\frac{5}{6}$: In like manner between the two next lines, you have the ſeries of all the twelve notes, in an octave from C *fa-ut* to C *ſol fa-ut*; the two firſt tones added together, make a greater third; and ſo you may add a tone or ſemi-tone, till you arrive at every interval in the octave, which is ſo call'd, becauſe eight ſounds are requir'd for expreſſing thoſe ſeven gradual ſteps, whereby we commonly aſcend to it; it may alſo be obſerv'd, that the proportions falling upon the ſame notes in two keys, one ſingle board will be ſufficient for both.

It is acknowledged by all that are acquainted either with ſpeculative or practical muſick, that each interval is divided into two parts, whereof one is greater than the other; an eighth $\frac{8}{9}$, into a fifth $\frac{2}{3}$, and a fourth $\frac{3}{4}$; again, a fifth $\frac{2}{3}$, into a greater third $\frac{4}{5}$, and a leſſer third $\frac{5}{6}$; thus alſo a greater third $\frac{4}{5}$ muſt be divided into tone major $\frac{8}{9}$, and a tone minor $\frac{9}{10}$; the leſſer third (to comply with the practice of muſick) is rather compounded of than divided into a tone major $\frac{8}{9}$, and an hemi-tone, which is its complement, $\frac{15}{16}$; three tones major, two tones minor, and two of the aforeſaid hemi-tones, placed in the order

order found in the figure, exactly conſtitute the practical octave; which is ſo called, becauſe it conſiſts of eight ſounds, that contain the ſeven gradual intervals; but it is alſo neceſſary to ſet down the diviſions of the whole tones, which are the true chronic half notes, becauſe there is great uſe made of them in practical muſick: To make all our whole notes, and all our half notes of an equal ſize, by falſifying the proportions, and bearing with their imperfections, as is the common practice may be allowed by ſuch ears as are vitiated by long cuſtom; but it certainly deprives us of that ſatisfactory pleaſure, which ariſes from the exactneſs of ſonorous numbers, which we ſhould enjoy, if all the notes were truly given according to the proportions here aſſign'd.

It is very eaſy to ſatisfy ourſelves in the arithmetical ſcheme, by thoſe operations, which *Gaſſendus* has ſet down in his manuduction to the theory of muſick, *Tom.* 5. p. 635; as for example, his rule for addition is, that two proportions being given, if the greater number of one be multiplied by the greater number of the other, and the leſſer by the leſſer, the two numbers produced exhibit the compounded proportions; thus, take a practical fifth $\frac{2}{3}$, and a practical fourth $\frac{3}{4}$ for the two proportions given, multiply 3 by 4, and you have 12, then multiply 2 by 3 and you have ſix, which compounded proportion of ſix to twelve makes the practical octave $\frac{1}{2}$; thus according to *Gaſſendus*'s arithmetical operations of addition, ſubſtraction, multiplication or continuation, and diviſion, is Mr. *Salmon*'s whole ſyſtem prov'd, which for the more eaſy application to practical muſick, is ſet forth geometrically upon the ſix ſtrings of a viol.

Theſe ſix lines repreſent in Fig. 9 the ſix ſtrings of the viol in the common tuning, the ſounding part of each ſtring from the nut to the bridge is ſuppos'd to be 30 inches long; the two middle ſtrings C and E are drawn out to 15 inches, the half of the whole; it is eaſy to meaſure every interval with a pair of compaſſes; ſuppoſe you are to take the 20th part of the ſtring G, it is an inch and a half, for the firſt half note; if you take the whole note from G to A, it is the tenth part and muſt be three inches; after theſe are taken away, your ſtring will be but 27 inches long; ſo that if you advance one note, or a major tone further, you muſt take a ninth part of it, which will be three inches more whereby you arrive at a greater third, being the fifth part of the whole ſtring; thus, the ſeries of all the notes may be demonſtrated; all the ſtrings are uniſon at the ſtops, where the tuning requires; ſo that, tho the proportions be carried

carried on as far as the frets allow, yet the ſtring is open, the ſame with the ſtop of that ſtring to which it is tun'd; and accordingly, the ſeries of the notes proceeds as if they were all upon a monochord.

This calculation ſerves but for two keys A and C, which are call'd natural, becauſe, they have no eſſential flats or ſharps; but becauſe the compoſer begins upon any key, and the ſeries of notes muſt take its *terminus à quo* from thence; the inſtrument-maker can provide ſuch moveable finger-boards, as ſhall ſerve exactly for every key; they are taken out and put in upon the neck of the viol with as much eaſe as you pull out and thruſt in the drawer of a table; three, or at moſt five of them will be ſufficient to accommodate all the keys that are made uſe of.

This mathematical fixing of the frets enables every practitioner who ſtops cloſe to them, to give the proportions of the notes in a greater exactneſs, than can be done upon the baſs-violin, or violin itſelf; ſince they may be ſet forth more perfectly by a pair of compaſſes dividing a line, than the niceſt ear can direct; tho' the frets for the ſeveral ſtrings do not ſtand in a ſtreight line, and the places are alſo ſhifted in different keys, yet the ear naturally directs the fingers to them; inſomuch, that thoſe who have all their life time been accuſtom'd to ſtop upon frets, that go quite croſs the finger-boards of their inſtruments, do with very little practice fall right upon theſe; ſuch is the power of a muſical genius, as may be undeniably prov'd, by thoſe that play upon a violin; who, when they change the key, fall upon the right ſtops, tho' they have no viſible direction where to ſtop, nor time to alter by the ear, the note they firſt pitch'd upon.

By this ſtandard of regular proportions, may the voice be form'd to ſing the perfecteſt notes; they are all the ſame in vocal and inſtrumental muſick; if then the inſtrument which governs the voice be perfect, the ear will of neceſſity bring it to perfection; it is a pity that a good natural voice ſhould be taught to ſing out of tune, as it muſt do if it be guided by an imperfect inſtrument; and this may be the reaſon, why ſo few attain to that melody, which is ſo much valued; but ſince we now know wherein perfection lies, a conſtant practice will bring us to the attainment of it: The dividing wholes into chromatic hemi-tones is very neceſſary, but very difficult for the voice to be broken to; if it learns from an inſtrument, whoſe whole notes and half notes are ſuppos'd to be equal, the ſound muſt needs be very uncertain and very unharmonical; whereas, the proportions being truly fix'd,

would bring it to perfection in the niceſt and moſt excellent part of muſick.

The chromatic hemi-tones are the ſmalleſt intervals our modern muſick aims at, tho' the ancients had their en-harmonic quarter notes, which they eſteem'd their greateſt excellency; theſe may alſo in time be recovered, ſince we know their proportions; for as the diatonic tone is divided into chromatic hemi-tones; ſo after the ſame manner, may the chromatic hemi-tones be divided into theſe leaſt en-harmonic intervals, which were always made uſe of; but if we go no further, yet this experiment demonſtrates the true theory of muſick, and brings the practice of it to the greateſt perfection.

The Bones *of a* Human Fœtus *voided thro' an* Impoſthume *in the* Groin; *by Sir* Philip Skippon. Phil. Tranſ. N° 302. p. 2099.

SIR *Philip Skippon* viſited a woman in *Drury-lane* 66 years of age, who had a child conſum'd in her *Uterus* for about 28 years; ſhe bore two children after this, the one liv'd 11 years, and the other ſix, about eight years before Sir *Philip* ſaw her; an impoſthume broke out in the right *Inguen*, and then ſeveral bones of a dead child were expelled, ſome of which he had by him; the patient had ſtill a large ſwelling in that groin where ſhe felt ſomewhat very hard, which ſhe ſuſpected to be bones.

An extraordinary Caſe of a Coſtive *Perſon*; *by Mr.* Sherman, *with an Obſervation thereon*; *by Mr.* Cowper. Phil. Tranſ. N° 302. p. 2116.

ONE *Thomas Philips*, of *Eaſthorp*, near *Keldon* in *Eſſex*, was well in every reſpect, till he was a year and quarter old; at which time a very ſtrange and almoſt continual rumbling in his inteſtines ſeized him, the conſequence whereof was a violent looſeneſs, for which all the phyſicians near the place could find no remedy; but at length, when the child's life was deſpair'd of, the looſeneſs terminated in ſuch an obſtruction, that he did not go to ſtool for a fortnight or three weeks together, and from three weeks it proceeded gradually to the intervals of 17 or 18 weeks; and continued ſo, till he came to be about the age of 15, when his body reſumed its natural temper, which laſted four or five years; but then the obſtruction returned, and it increaſed till he died; for it was cuſtomary with him in the latter years of his life

life not to evacuate any *Fæces*, under the interval of 19 or 20 weeks, and ſometimes, (twice at leaſt) he had no diſcharge for 21 or 22 weeks together; he lived to be near 23 years of age, and walked about almoſt to the hour of his death; for he was ſuddenly ſeized with very ſick fits, but could not vomit, two or three of which fits carried him off in a few hours, and he died nine weeks after he had had any ſtool: The patient never vomited, nor had at any time any excrementitious taſte in his mouth; neither did he ſweat much, nor make more urine, than in proportion to his drinking: When the patient went to ſtool, he evacuated ſeveral times in a day, and that for ſeveral days together; 'till he had emptied himſelf; and throughout his whole life, he never diſcharged any other than very thin *Fæces*; before the time of evacuation came about, he was of an extraordinary bigneſs ſeveral weeks before his going to ſtool, unleſs he could break wind, which he often endeavoured to do, by laying his body on the edges of a table or ſtool, but often to no purpoſe; he declined the uſe of any medicines for ſeveral weeks before he died, contenting himſelf with going to ſtool once in three or four months, or in 19 or 20 weeks, as abovementioned; but what was ſurpriſing, was, that he generally had a pretty good appetite, and eat and drank as the reſt of the family did; nay, till the time that his body came to be very full, he could work at the plough, or ſuch like husbandry labour.

Mr. *Cowper* obſerves, that it is not improbable, that had this perſon's *Abdomen* been opened, ſome of its contents would have been found not unlike thoſe mentioned in his explication of the 34th table of *Bidloo*'s figures; where Mr. *Cowper* obſerved in a young gentlewoman he had diſſected, the *Omentum* ſo much diminiſhed, that at firſt it appeared doubtful, whether that part had ever exiſted in that ſubject; but, upon a ſtrict examination, the ſmall remains thereof reſembled a *Congeries* of ſmall glands, ſtuffed with a ſuet-like matter; the whole inteſtinal canal, even from the *Pylorus* to the *Anus*, was diſtended with *Fæces*, and the ſurfaces of all the ſmall guts adhered ſo cloſely to each other, that they could not be ſeparated, without tearing their external membrance, to which the *Omentum* contributed by its adheſion; the whole *Compages* of the inteſtines very much reſembled that of the external ſurface of the brain, covered with the *Pia Mater*; ſo that the meſentery in that ſubject could not be ſeen, till this external incloſure was divided; it is certain, that, by this diſorder, the periſtaltic motion of the guts muſt needs have been

very much impaired, if not quite hindred; the *Peritonæum* was likewiſe in that caſe very much thickened, and had ſeveral preternatural white bodies ſet at various diſtances on its internal ſurface; the like appeared on the ſtomach, which very much reſembled in figure the milliary glands on the back part of the *Aſpera arteria*

An Eruption of Blood from ſeveral Parts of the Body, and a Colic ariſing from the Coaleſcence of the Inteſtines, into a thick and cartilaginous Subſtance; by M. Antonius Meſaporitus; Phil. Tranſ. N° 303, p. 2144. *Tranſlated from the* Latin.

A Certain young woman had enjoyed a perfect ſtate of health, was naturally of a chearful diſpoſition, till the 18th year of her age, when having undergone a variety of diſorders, ſhe was afflicted with a flux of blood from unuſual parts of her body, and at length with a diſmal ſort of partial ſweat; after a laſting pain in her ſtomach, ſhe began to cough up blood, occaſioned by a ſpurious pleuriſy with which ſhe was taken, accompanied with a pain in her ſide, and a difficulty of breathing; the diſorder in her breaſt going off on the fourth day after, ſhe was afflicted with a head-ach, under which ſhe had formerly laboured, and was obſerved to have an effuſion of blood at the noſe, yet without any relief; wherefore, the ſurgeon blooded her largely in the foot, as he had formerly twice drawn a fizy ſort of blood from her arm; yet for all this, her diſorder did not decreaſe; after this, the patient had a *Cardialgia*, or heart-burn, which made her at firſt vomit up a viſcid green matter, and then blood, and that in a certain regular period for many days, yet without being relieved of her head-ach; this troubleſome viciſſitude of diſorders ſtill continued to rage, when about the beginning of *May* her *Menſes* returned, and that in a ſufficient quantity, as ſhe was wont to have them; after the ſeventh day, the ſurgeon gave her a potion of *Manna*, with which tho' ſhe was very much diſordered and ſeemed to grow worſe, yet a little after, her fever entirely left her, which before had been more or leſs a continued fever, with watchings; her diſorder had ſcarce intermitted for a week, when her fever returned again, attended with a pain in her joints, and particularly in her belly, from which tho' ſhe was ſoon relieved by taking *Oleum Amygd. dulcium rectif.* extracted without fire, yet her continual vomiting and loſs of blood, afflicted her much: To remove this dangerous ſymptom, the phyſicians adviſed bleeding in ſmall

ſmall quantities, and at proper intervals, in the *Salvatellâ*, and the application of anodynes, aſtringents, &c. which tho' accordingly done, yet the diſorder taking an irregular courſe, after it had gone the round of all the common excretories, began to flow at unuſual parts; about the beginning of *June* blood run at her ears, a little after, at the points of her fingers, and then of her toes; preſently after at the *Umbilicus* and corner of the eye; ſeveral times by ſweat, and at length it burſt out from the middle of her breaſt, afterwards in the foot, where the *Saphena* is prickt in bleeding; then at both palms and back of her hands; two days after it flowed from her chin, and in the night-time from the tip of her tongue, and all this in a fortnight's time: M. *Meſaporitus*, paying a viſit to this patient, was ſurpriſed to find, that ſhe had ſome tolerable degree of ſtrength and a chearfulneſs of countenance; a ſmall print, like an unequal puncture, was ſtill to be ſeen in the palm of her left hand, from whence the blood had flowed the day before, and as ſhe ſaid, with a ſenſible pain; as was always the caſe when it flowed from any particular place; but when from her breaſt, or other parts like ſweat, there was no veſtige of an orifice to be ſeen, only the blood on her linen; on the 14th of *June* her *Menſes* returning in a greater quantity than ordinary; ſome ſuppoſed, becauſe it had intermitted for 20 days, that the diſorder was removed; but a ſecond ſweat coming on, and continuing for ſome time, ſhe found her ſtrength impaired, and the diſcoloured blood appear; change of air proved ineffectual towards a cure, it rather made the patient worſe.

M. *Meſaporitus* happened to be preſent, when ſhe felt a twinging pain in the extremity of one of her fingers, whereby ſhe was appriſed that an eruption of blood would ſoon enſue; he obſerv'd it to drop from a deep puncture, and immediately from another not far off; three days after ſhe had a very plentiful bloody ſweat, and little or none ever after; it was obſervable, that, from a ſlight excoriation above the *Malleolus*, occaſioned by ſpraining her foot, there flowed a plentiful quantity of *Serum*, which could hardly be ſtopped either by ſtiptics, or bandages.

To confirm this ſurpriſing *Phænomenon*, *Fabricius Ardiſonus* relates, that he cured a woman of 30 years of age, who had a ſuppreſſion of the *Menſes*, and flux of blood at the corner of her eye by promoting their regular courſe; and there are other ſimilar inſtances to be found in authors, as in *Benivenius*, *Hollerius*, &c. tho' in all theſe, ſome obſtruction might occaſion an extravaſation, yet in the preſent caſe, obſtructions can have no place; as appears from the very ſubtile criſis of the blood; whence at

firſt,

firſt it was florid, and preſently after ſufficiently diluted; and tho' at firſt it was obſerved to be ſizy, that does not at all evince the groſſneſs of its ſubſtance, but only a greater elixation of its parts, which are apt to coagulate, as is particularly evident, in letting blood in the height of a fever; and as M. *Meſaporitus* obſerved, of a young lady in an acute diſeaſe, that inſtead of blood, there flowed a white thin *Serum* from her vein, which afterwards coagulated; yet he acknowledges, that this is no ways an adequate cauſe to ſatisfy philoſophers, whom he leaves to determine the preciſe and inſenſible diſpoſition of the blood.

A country-man being for ſome time, extenuated and afflicted with gripes, and hypocondriac ſpaſms, could hardly diſcharge any thing by ſtool; at length, being quite ſpent, he languiſhed and died: Upon opening his body, the thick guts, eſpecially at their flexure near the *Duodenum*, were found to be firmly united to each other, and the adjacent guts, by intermediate callous protuberances, ſo that they could hardly be ſeparated; and beſides, their ſubſtance was grown hard, like a cartilage, and become ſo thick, that there was ſcarcely any cavity remaining.

The ſolution of a Problem *concerning the determinate Doſes of Purging and Emetic* Medicines; *by Dr.* Cockburn. Phil. Tranſ. N° 303. p. 2119. *Tranſlated from the* Latin.

THE better to determine the different doſes of emetic and purging medicines, according to the variety of conſtitutions and ages; 1. We muſt ſuppoſe that ſuch medicines cannot operate, before they have got into the maſs of blood, and are entirely mixed therewith; for it is evident, that unleſs they provoke a *Nauſea*, no ſenſible effect is produced by them long after they are conveyed thither. 2. That their more general effect is an alteration of the temperament of the blood, and other humours of the body: From theſe two *Poſtulata* Dr. *Cockburn* concludes, that where the *Craſis* of the blood is the ſame, there the doſes of medicines, to produce a determinate effect, ſhould be proportional to the quantity of blood; for if for inſtance, a determinate doſe is required to alter in a determinate degree, the *Craſis* of one pound of blood; double that doſe given to alter in the ſame degree, the *Craſis* of two pounds; and triple, to alter in the ſame degree that of three pounds of blood, &c. and univerſally, if the quantity of blood b require the doſe d, the quantity of blood $m\,b$ will require the doſe $m\,d$, and $b : d :: m\,b : m\,d$.

Coroll.

Coroll. Seeing the quantity of blood, and other humours that circulate regularly in the body, may be eſtimated from the weight of the animal, for the parts we call ſolids are only canals that contain thoſe liquors; from hence it follows, that the quantities of doſes, *cæteris paribus*, are proportional to the weight of the body; and conſequently, that the doſe of medicines to be given a new-born infant, is to the doſe of the ſame medicines to be adminiſtred to a man of riper years, as the weight of the infant is to that of the man; *e.g.* 30 grains of *Pilul. Rudii* are generally given in one doſe to a man, and the weight of a man is commonly 160 *l.* and that of an infant 12 *l.* wherefore, as 160 the weight of a man is to 12 the weight of an infant, ſo are 30 grains the doſe of a man, to $2\frac{1}{4}$ grains, the doſe of an infant; and the doſes of infants are always to be augmented in the ratio of their increaſe; ever after the doſes to be given continue the ſame to the 50th year of a perſon's age; after which time, both the quantity of the blood and ſtrength are daily diminiſhed, and in that ratio the doſes of medicines ſhould alſo be diminiſhed: By this way of reaſoning, which is the more ſimple caſe, Dr. *Cockburn* ſuppoſes, that all men enjoy the ſame temperament of body; as alſo, that the increaſe and order of the ſecretions are, to a number of years equal; but, ſeeing that the temperaments or conſtitutions of men are very different, according to the different *Craſis* of the blood, and other humours in the body, the quantities of doſes are not always proportional to the weight of the body; that the different temperament of the blood conſiſts in a certain diſpoſition or coheſion in its particles, whereby the blood becomes more or leſs fluid; whence it happens, that the operations of medicines upon the blood are different, according to the different degrees of coheſion; for let us ſuppoſe, two men having an equal quantity of blood, but of different degrees of coheſion; it is plain, that thoſe medicines ſhall more eaſily mix with the blood of a laxer, than with that of a cloſer contexture; and the propenſity wherewith the particles of medicines mix with thoſe of the blood, is always directly as the fluidity, or reciprocally, as the tenacity of the blood; and the force of the medicine upon the blood will in like manner be in the ſame ratio; and therefore, that a medicine may operate equally upon men of different conſtitutions, the doſes to be adminiſtred ſhould be proportional to the tenacity of the blood; ſuppoſing, the velocity of the circulation in both to be equal; but if the velocity of the blood be different, the operations of the medicines, that is, the quantity of ſecretions produced by them, will be as the velocity of the blood

blood; for the ſecretions in any gland, in a given time, are always as the quantity of blood, which is conveyed at the ſame time into that gland; that is, at its velocity; the velocity alſo of the blood, *cæteris paribus*, is always as its fluidity, or reciprocally as its degree of coheſion; if therefore the velocity of the blood were only to be conſidered, in that caſe the quantity of the doſes to produce the ſame effect will be directly as the degrees of coheſion in the particles of blood.

Prop. I. *In two men having an equal quantity of blood, but of different degrees of coheſion, the doſes of purging and emetic medicines, neceſſary to produce the ſame effect, are in a duplicate ratio of the degrees of coheſion in the blood.*

For, where the blood moves with the ſame velocity, the quantity of the doſe muſt be as the degree of coheſion; and if the degrees of coheſion were the ſame, the quantity of the doſe is reciprocally as the velocity; therefore, where neither the coheſion, nor velocity are the ſame, the quantity of the doſe is in a ratio compounded of the direct ratio of the degrees of coheſion in the blood, and the reciprocal ratio of the velocity; but the reciprocal ratio of the velocity is equal to the direct ratio of the degrees of tenacity or coheſion; conſequently, the quantity of the doſe is in a compound ratio of that of the degrees of coheſion, and the degrees of coheſion, that is the doſes to be taken are in a duplicate ratio of the ſame, Q. E. D.

Prop. II. *The quantity of doſes to be given, men having different quantities of blood of different degrees of coheſion, is in a ratio compounded of the ratio of the weight of the men, and of the duplicate ratio of the degrees of coheſion.*

For, when the degrees of coheſion are the ſame, the quantity of the doſes is as the weight of the men; and where the weight is the ſame, the quantity of doſes is in a duplicate ratio of the degrees of coheſion; and therefore, when neither is the ſame, the quantity of the doſe is in a ratio compounded of the ratio of the weight of the men, and the duplicate ratio of the degrees of coheſion, Q. E. D.

Coroll. Hence knowing the quantity and quality of blood in any man, it is not ſo difficult a matter to determine the doſes neceſſary to purge and vomit him; this quality, or temperament of the blood, is eaſily diſcovered by a ſkillful phyſician from the pulſe, urine, and other ſecretions; and therefore, a phyſician, obſerving the doſes that purge men of a given conſtitution, may very readily determine the doſes proper for any conſtitution or temperament.

Schol.

Schol. What has hitherto been demonſtrated in general, which follow in like manner from the common hypotheſis of phyſicians, about purging and vomiting; becauſe the diſpoſition, which the ſtomach and inteſtines have to be ſtimulated, is as the above-mentioned degrees of the quantity and coheſion of the blood; and thus the ſame truth would be very evident even from that hypotheſis, tho' it has not that ſimplicity of a poſtulate, and for that reaſon is not made uſe of.

An Explanation *of the* Rule *for finding* Eaſter; *by Mr.* Jackman. Phil. Tranſ. N° 303. p. 2123.

THE rule for finding *Eaſter* in the *Common Prayer Book*, is thus worded; *viz.* Eaſter-day *is always the firſt* Sunday *after the firſt full moon, which happens next after the one and twentieth day of* March; *and if the full moon happens upon a* Sunday, Eaſter-day *is the* Sunday *after*; for the right underſtanding of which, it is ſufficient to obſerve, 1. That the full moon meant is the 14th day of the moon, according to the kalender in the *Common Prayer Book*, (which may be called the *Church Kalendar*) reckoning that day of the month for the firſt day of the moon, which has the golden number of the year collateral to it in the firſt column of the ſaid kalendar; and 2. That theſe words, *next after* March 21, are meant incluſively, as if it had been ſaid, next after the commencement of *March* 21; ſo that if the full moon happen on *March* 21, the ſame muſt be the paſchal full moon: Now, in order to prove that theſe obſervations are both right and ſufficient for underſtanding the rule, Mr. *Jackman* only ſuppoſes, that if they are neceſſary and ſufficient to reconcile the rule with the authentic table to find *Eaſter*, (from which practice never varies) then are they right and ſufficient, which being premiſed, 1. he proves, that the juſt obſervation, is neceſſary to that end; becauſe if the paſchal full moon be any day before or after the 14th of the moon by the Church Kalendar, then the rule and the table will claſh; for 1. if it be any day before, then as often as the ſaid 14th of the paſchal moon is a *Sunday*, that very day, at lateſt, muſt be *Eaſter-day* by the rule, as being a *Sunday* after the full moon therein meant; whereas, by the table and practice, it is not till the *Sunday* following that; thus, *Sunday*, *April* the 1ſt, in 1705, was the 14th day of the moon by the Church Kalender, and therefore muſt have been *Eaſter-day*, or after by the rule, if the full moon therein meant had been any day before the ſaid 14th of the moon; whereas *Eaſter-day* was *April* the 8th by the table, and accordingly obſerved;

ſerved; and this obliges us not to underſtand the true full moon, by the full moon in the rule; becauſe that happens, about four days before the 14th of the moon by the Church Kalendar. 2. If the full moon meant in the rule be any day after the 14th of the paſchal moon by the Church Kalendar, then, as often as the ſaid 14th happens to be *Saturday*, and conſequently the full moon meant in the rule to be the *Sunday* following at ſooneſt (that being the very next day) that *Sunday* cannot be *Eaſter-day* by the rule; whereas by the table and practice it is: Thus *Saturday*, *April* 4. 1702, was the 14th day of the moon by the Church Kalendar; and therefore, if the full moon meant in the rule was any day after that, it muſt have been on *Sunday April* the 5th at ſooneſt; conſequently, *April* the 12th at ſooneſt muſt have been *Eaſter-day*, by the rule; whereas, *April* the 5th was *Eaſter-day* by the table and practice; and this evinces the miſtake of thoſe, who make the 15th day of the moon to be the full, in the ſenſe of the rule; as Dr. *Wallis*, *Phil. Tranſ.* N° 240; Mr. *Wright* in his poſtſcript to his *Short View of Mr.* Whiſton's *Chronology*, &c. as alſo the *Introductio ad Chronologiam* (reprinted at *Oxford*, A.D. 1704) p. 37. 2. Mr. *Jackman* proves the ſecond obſervation neceſſary to the ſame end; becauſe, a full moon in the ſenſe of the rule, (*viz.* the 14th day of the moon by the Church Kalendar) often happens on *March* 21; and in that caſe the *Sunday* following is always *Eaſter-day* by the table, and practice; whereas, it muſt be a month after by the rule; unleſs we underſtand theſe words (*next after* March 21ſt) as Mr. *Jackman* explains them; and this will be the caſe the enſuing year, 1706; nor does the proof of this point need the ſuppoſition of the foregoing (tho' that may now be fairly ſuppoſed, as being already proved) for, compute the full moon how you will, *March* the 22d can never be *Eaſter-day* by the rule, unleſs *March* 21 may be the paſchal full moon by the ſame; and yet *March* 22 is *Eaſter-day* by the table and practice, as often as the golden number is 16 and the dominical letter D.

Mr. *Jackman* was aware that the ſecond obſervation might ſeem forced and unnatural; and that, perhaps, might induce ſome to reckon the 15th day of the moon for the full in the rule; and Mr. *Thornton*, *Phil. Tranſ.* N° 297. to ſubſtitute *March* 20. in leap-years, for *March* 21; neither of which hypotheſes, however do any ſervice, all things being conſidered; the former, indeed, would vacate Mr. *Jackman*'s ſecond obſervation (*March* 21 never being the 15th day of the moon by the church kalendar) but then, it would make the rule notoriouſly irreconcileable with the

the table and practice, as has been already ſhewn; and as to Mr. *Thornton*'s hypotheſis; 1. The only colour for it (*viz.* that at the time of the council of *Nice*, the vernal equinox was *March* 20, in leap-years, and not *March* 21, as in common years) is, for any thing Mr. *Jackman* knows, more likely to be falſe than true, and does by no means follow from the intercalation. 2. If this pretence were true, it were too great a nicety, probably to have been regarded by the church. 3. This hypotheſis puts more force upon the words of the rule, than Mr. *Jackman*'s does; and laſtly, if it were admitted, it would ſolve the difficulty only in leap-years; and Mr. *Jackman*'s ſecond obſervation would ſtill remain neceſſary, becauſe the caſe happens, as well in common as in leap years; whereof, we have an example in the year 1706; nor will Mr. *Jackman*'s ſecond obſervation be much queſtioned by ſuch as know, and conſider the incluſive way of reckoning uſed by the *Romans*, and from them derived to all the *Latin* Churches, and particularly that of *England*; for it is as proper to ſay, (*next after* March 21.) with the meaning Mr. *Jackman* contends for; as to ſay, *tertio ante calendas, nonas, vel idus*, in the ſenſe of the *Roman* kalendar; or as to ſay (as our church does a little after this rule for *Eaſter*) that *Aſcenſion-day* is 40 days after *Eaſter*, intending *Eaſter-day* itſelf to be one of thoſe 40; and it is obſervable in this very rule, that after it had been ſaid, *that* Eaſter-day *is always the firſt* Sunday *after the full moon*, &c. it is added, that, *if the full moon happens upon a* Sunday, Eaſter-day *is the* Sunday *after*; which had been a groſs tautology, if by the firſt *Sunday* after the full moon might not be underſtood the day of the full moon itſelf, when happening to be *Sunday*; and if the *Sunday* of the full moon may be ſignified by the firſt *Sunday* after the full moon, then the full moon of *March* 21, may be ſignified by the full moon next after *March* 21. 3. He proves, that his two obſervations are ſufficient to reconcile the rule and the table; becauſe, Mr. *Jackman* himſelf had drawn up a table to find *Eaſter* for ever, by the rule underſtood according to thoſe obſervations, and the plain and obvious ſenſe in all other reſpects; and, upon comparing, he has found it agree in every particular with the table for the ſame purpoſe in the *Common Prayer Book*.

Some Norman Coins *found at* York; *by Mr.* Ralph Thoresby. Phil. Tranſ. N° 303. p. 2127.

SOME workmen in digging below the foundations of a houſe that was burnt down in *High Ouſegate*, diſcovered at a conſiderable depth, the foundations of an older fabric, very probably unknown to the builders of the latter houſe; theſe lower foundations were very well ſupported at ſeveral angles with good oak-piles, ſome of which were ſo firm and ſound, that they were fit for that purpoſe again; beſides theſe piles, there were ſeveral large timbers, that lay athwart, to make the foundation the ſtronger; betwixt the head of two piles the workmen found a little decay'd oak-box, wherein had been hoarded about 200 or 250 pieces of *Norman* coins; but time and the moiſtuee of the place had defaced them in ſuch a manner that not above 100 of them could be preſerv'd; Mr. *Thoresby* having perus'd about half of them, found that they were of *William* the Conqueror's coins, and not above two or three in the whole of any other prince; thoſe tho' later in time, are more valuable than ſeveral of the *Roman* and *Saxon* coins; and theſe lower foundations do likewiſe very well agree with the accounts we have of the timber buildings in thoſe ages: The coins were very much alike; the king is repreſented full fac'd, with a crown and labels, but no ſceptre, croſs, or ſtar, as Mr. *Thoresby* obſerv'd in other coins of his which he had; moſt of theſe coins were inſcrib'd WILLEMV REX, which ſome have miſtaken for *William* 2d; but by the declining of the ſtrokes, it appears to be deſign'd for V, as Mr. *Thoresby* had one with the S after the V, and before REX; by this circumſtance there appears a greater variety than was ever known before, of the Conqueror's money; Mr. *Thoresby* had ſuch ſorts as theſe, *viz.* WILLEMV REX. WILLEMVS REX. WILLEMV REX. I. (which is not to be reckon'd a numeral letter, it being proper to pretend a diſtinction, when there was none of the name before; but for part of the letter A) WILEM. REX A are *Angliæ*; and Mr. *Thoresby* had ſome coin'd on the reverſe at LUNDRE *i. e. London.* EOFER *wick (York)* WINC. *(Wincheſter)* EXETE. *(Exeter)* LIN. (Mr. *Thoresby* ſuppoſes to be *Lincoln Lyn-Regis* not being old enough) LINCOL *(Lincoln)* DEOTFORND *(Thetford)* and LOYNC (which Mr. *Thoresby* takes for *Loyn* or *Lancaſter*:

Mr.

Mr. *Thoresby* had one inſtrib'd thus + WILLEMVS REX I. the reverſe + DEI. GRATIA.

Several Experiments on the Mercurial Phoſphorus *by Mr.* Hauksbee. Phil. Tranſ. N° 303. p. 2129.

EXperiment I. *Shewing that light may be produced from* mercury, *by paſſing common air thro' its body, after the receiver is well exhauſted.*

Mr. *Hauksbee* took a glaſs recipent, open and ground at both extremities, whoſe contents were equal to about 30 ounces of water; the upper orifice was clos'd with a braſs plate by means of a piece of wet leather laid on the edge of it; in the middle of this plate there was a ſtop-cock ſcrew'd, from whoſe lower orifice was inſerted by cement a ſmall glaſs tube, reaching from thence to the bottom of a glaſs, included in the above-mentioned receiver; in which glaſs there was put as much mercury as would cover the bottom of the tube about $\frac{1}{4}$ of an inch; and being thus prepared and placed upon the pump, the ſtop-cock was turn'd to hinder the air paſſing that way, till the receiver was ſufficiently exhauſted; which being done, and the ſtop-cock returned, the air then ruſh'd ſtrongly thro' the body of the mercury (by paſſing the tube above-mention'd) blowing it up with violence againſt the ſides of the glaſs that contain'd it; and it appear'd all round like a body of fire, compos'd of a great many glowing globules; and it deſcended again into itſelf, the phænomenon continuing till the receiver was half full of air.

Exp. II, *Shewing that* mercury *will appear like a ſhower of fire whilſt it deſcends* in vacuo, *from the top to the bottom of a tall receiver.*

Mr. *Hauksbee* having got ready a tall receiver about 21 inches high, to whoſe upper orifice there was ſcrewed a glaſs (reſembling thoſe now commonly us'd for cupping) with an open paſſage thro' its neck, in which paſſage there was cemented a piece of a ſmall tube, drawn taper at one extremity by the flame of a candle, which together with the cup made an entire funnel; its ſmall aperture was ſtopped with a round piece of timber as a plug, to prevent the mercury entering the receiver before its time; within this tall receiver there was included a glaſs about 17 inches high, with a round crown-like a ſhade; in this manner being placed on the pump, and about a pound and a half of mercury put into the funnel, the air begun to be exhauſted, and in two minutes time was ſufficient to exhibit the *Phænomenon*; for then looſening the plug that ſtopped the funnel, the mercury, by the preſſure of the air, was driven violently into the receiver, ſtriking

ſtriking ſtrongly on the crown of the included glaſs, which broke the quickſilver into ſmall particles, deſcending all round the expoſed ſides of both the glaſſes, and appearing like a ſhower of fire in a very ſurpriſing manner; the form of the receiver, as well as of the included glaſs, was very diſtinguiſhable by its light, and continued ſo, till all the mercury had entered thro' the funnel: What further occurred to Mr. *Hauksbee*'s obſervation was, that the deſcending mercury did more reſemble the falling of ſnow, by the ſlowneſs of its motion, than that of rain; and that none of it appeared luminous, but what deſcended contiguous to the ſides of the glaſſes; and that ſome of the globules of mercury deſcended quicker than others, according to their different magnitudes; that the deſcending globules of light (as by a ſtrict obſervation Mr. *Hauksbee* had afterwards made) did not ſlide down the ſides of the glaſs, but were carried round by their own weight, as if they revolved on an axis; and what was remarkable, the deſcending globules had a double motion, the one perpendicular, the other like a rotation on an axis; and in that motion the adhering parts of the mercury were continually tearing from the ſides of the glaſſes, producing an apt form, which in ſuch a medium, from ſuch a body exhibited light, that the ſmaller globules, whoſe weight was not ſufficient to cauſe their deſcent, remained opaque, there being (in this, as well as all other mercurial experiments) no light to be obtained without motion; that the ſame motion given to the like globules of mercury in common air, does not produce the ſame effect, as Mr. *Hauksbee* tried, by forcing mercury thro' leather, which he did by condenſing air ſtrongly on its ſurface; from all which it ſeems to appear very plain, that there is requiſite the concurrence of a proper figure, medium, and motion to produce the mercurial *Phoſphorus*.

Experim. III. *Shewing, that it does not require ſo thin a medium, as is made by the weight of the mercury in the* Torricellian *experiment, to produce the mercurial* Phoſphorus.

To try whether ſo thin a medium as a *Vacuum*, or the neareſt approach to it, was abſolutely neceſſary in the production of ſuch a light, as is diſcoverable in the barometer, by putting the mercury in motion, Mr. *Hauksbee* made uſe of the gage belonging to his air-pump; upon the plate of the pump be placed a ſmall receiver, from which the air being exhauſted, the mercury in the gage was elevated to 29 inches and $\frac{1}{2}$; then permitting ſome air to re-enter the receiver by the cock, and the mercury in the gage deſcended, and made ſeveral vibrations before it became ſtagnant,

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in all which it appeared luminous, only whilſt deſcending, till the mercury was broke on purpoſe by a violent agitation thereof; then the ſeparate parts appeared luminous on their lower ſurfaces, which became concave during their aſcent, as the others were, when they exhibited their light in their deſcent, the convex ſurfaces being always opaque; theſe appearances continued upon every admiſſion of air, till near the half was admitted; but after that, tho' the mercury had the ſame motion given it as before, yet no manner of light enſued; hence it readily appears, that tho' the mercurial *Phoſphorus* in the *Torricellian* experiment, is not produceable in ſo denſe a medium as common air; ſo on the other hand, it requires a medium not ſo thin by much, as the neareſt approach to a *Vacuum* to effect it.

Experim. IV. *Shewing that a conſiderable light may be produced from* Mercury *in a glaſs, by putting it into motion, before the receiver is quite exhauſted.*

Mr. *Hauksbee* having provided ſome mercury, which was very fine, and free from the leaſt appearance of ſoil on its ſurface, the glaſs which held it being alſo very clean and dry; and both glaſs, and the contained mercury were included in a receiver on the plate of the pump, from which Mr. *Hauksbee* preſently began to exhauſt the air; but before it was quite exhauſted (the mercury in the gage not exceeding 28 inches, the barometer at the ſame time ſtanding at 29 inches and $\frac{4}{5}$) the pump was ſhaken, by which means the mercury in the included glaſs being put into motion, exhibited ſuch a light, that not only the receiver and included glaſs were thereby diſtinguiſhable, but the hands and fingers on the outſide were ſo too; it is to be obſerved, that tho' the mercury would exhibit a light upon a little motion, yet the light was increaſed upon increaſing that motion; what further occurred was, that when a pretty briſk agitation was given the mercury, it would reſemble waves of light breaking on the ſides of the glaſs, ſcattering ſome ſpecies of the ſame appearance towards the upper part thereof; that upon the repetition of the experiment, three or four times the *Phoſphorus* ſeemed to be more vivid every time; till at laſt, by often ſhaking the mercury, its ſurface became ſomewhat ſolid, which rendered the light leſs than it had been before; that in this, as well as in all other mercurial experiments, the light exhibited is of a very pale colour; that the firſt appearance of this light, is when about half the air contained in the recipient is exhauſted, which ſtill increaſes with the rarefaction; and with all the laſt confirms the neceſſity of a rarefied air to ſuch a degree, to produce the mercurial

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Phoſphorus, concurring with that made by the motion of the mercury in the weather-glaſs.

Experim. V. *Shewing very odd flaſhes of light (upon the repetition of the experiment) reſembling a ſhower of fire.*

The appearance in this experiment was not only very ſurpriſing, but diſtinguiſhably the cleareſt and moſt vivid light in all the mercurial *Phoſphori*, produced in rarified air: Upon the repetition of the ſecond experiment, and with the ſame *apparatus*, the mercury did not only appear like a ſhower of fire, but from the crown of the included glaſs there were frequently darted flaſhes reſembling lightning, of a very pale colour, and very diſtinguiſhable from the reſt of the light produced; the flaſhes ſeemed then to be darted horizontally, tho' at other times Mr. *Hauksbee* had obſerved them to incline upwards, and ſometimes downwards; and ſometimes from divers parts, as well from the outer receiver as from the included glaſs; they generally fly to the ſide of the outer receiver (unleſs their origin begins there, as Mr. *Hauksbee* had ſometimes obſerved) where the light breaks, and ſpreads in a very odd form; ſomething farther obſervable was, that the crown of the included glaſs ſenſibly appeared more luminous than any other part thereof, which light was conſtant, without any alteration, during the deſcent of the mercury thro' the funnel, and that was at leaſt two minutes of time; the quantity of mercury uſed for this experiment, was about three pounds.

Experim. VI. *Shewing that a great number of particles of light are diſcoverable, by ſhaking* Mercury *in a glaſs even in the open air.*

In ſome of the former experiments, where Mr. *Hauksbee* aſſerted that the mercurial *Phoſphorus* is not produceable, but in ſuch a medium, there he would have it underſtood, that he means a light of the ſame nature and quality with that diſcovered in the barometer, by putting the mercury into motion; which light is very different from what is made by ſhaking mercury in the open air, which was very ſenſible in the preſent experiment; for having put into a clean glaſs globe (whoſe content was equal to about 30 ounces of water) about $\frac{1}{3}$ a pound of pure mercury, then cloſing its mouth with a braſs cap, in the middle of which was inſerted a cock, by which means there was a free communication with the external air; the globe being ſhaken, the particles of light appeared plentifully, about the bigneſs of a ſmall pin's head, very vivid, reſembling bright twinkling ſtars, exhibiting ſome ſmall faint light, like the whitiſh appearance of the

the *Via lactea*; their numbers increaſed according to the rapidity of the motion communicated to them; Mr. *Hauksbee* then took the ſame glaſs, with the ſame mercury, and applied it to the pump, by means of a hollow braſs pipe, which ſcrewed on, both to the cock and pump, and when the air was exhauſted and the cock turned, to prevent the return of the air again, and when it was taken off, and moderately ſhaken, the mercury then appeared luminous all round, not as before, like little bright ſparks, but like a continued circle of light, during that motion; but when that motion was checked with another of greater violence, it then appeared luminous almoſt all over the globe; upon ſuffering the air to return, that mode of light vaniſhed; nor could any thing be recovered by ſhaking, but only the bright ſparks, as at firſt.

Magnetical Experiments *and* Obſervations; *by Mr.* Derham. Phil. Tranſ. N° 303. p. 2136.

MR. *Derham*, having invented an azimuth compaſs, as he was preparing it for obſerving the magnetic variation, took occaſion to try divers magnetic experiments, and by that means diſcovered this odd phænomenon; *viz.* having touched a piece of wire, ſo that it tended ſtrongly N. and S. he had a mind to ſee whether it would have any inclination to either of the *Poles* of the world, when turned round like a ring, ſo as that the two extremities of the wire met; and having ſtraitened it again, he was ſurpriſed to find it had quite loſt its verticity; the cauſe of which, he preſently concluded, to be the contact of the northern and ſouthern extremities of the wire, which he thought might ſo influence each other, as to confound its poles; tho' he had never obſerved any ſuch confuſion to ariſe upon the bare contact of the northern and ſouthern extremities of two other touch'd pieces of wire; hereupon, Mr. *Derham* touch'd the ſame and other pieces of iron wire ſtrongly, and finding them all turn eagerly N. and S. he coiled them round in ſuch a manner, that the extremities ſhould not come near each other; and he again ſpeedily opened them ſtrait, and found as before, that every piece had utterly loſt its verticity; nay, the magnetic virtue was ſo abſolutely deſtroyed by bending the wire, that it had not only loſt its inclination to either *Pole*, but the two extremities of each wire ſeemed indifferent to the poles of the loadſtone; *viz.* whereas, before the bending, the contrary poles of the loadſtone would repel, and the ſimilar poles attract the adverſe, or ſimilar extremities of the wire; now the repulſive virtue

was quite extinguiſhed, and either extremity would be indifferently attracted by either pole of the magnet, all one as if the wire had been heated red hot (which is well known to deſtroy the virtue) or never had been touched at all: This Mr. *Derham* had ſeveral times experimented upon wires of different lengths, with the ſame ſucceſs; only this muſt be obſerved, if you only bend the wire round in ſuch a manner, that it ſhall ſpring back into its place or recoil, ſo as to be nearly of the ſame ſtraitneſs, that then no ſuch, or but little of ſuch effect will enſue; but to produce this effect, the wire muſt be ſharply bent, ſo as that violence may be exerted thereon; if it is coiled two or three times about a ſmall round ſtick, it will ſucceed beſt; and farther alſo it is neceſſary, that every part of the wire ſhould be bent, to deſtroy the magnetic virtue; for if the extremities, or any other part happen not to ſuffer the violence of bending, that part ſhall retain its magnetiſm; as for inſtance, if the wire is all coiled, excepting half an inch, or indeed, half a tenth of an inch at each extremity, every part ſo coiled ſhall both loſe its verticity, and ſhall incline indifferently to either pole of the magnet; but the two extremities (altho' not able to turn the whole wire N. and S.) ſhall fly from, or tend to the reſpective pole of the magnet; or if every part of the wire be coiled, excepting a ſmall bit at each extremity only, all that coiled part when extended, ſhall be utterly deprived of its magnetiſm as before; and only that uncoiled bit retains its averſion, or inclination to the magnetic poles: From the conſideration of all which particulars, it is very manifeſt, that the violence exerted upon the wire by bending, utterly extirpates the magnetic virtue, or at leaſt makes ſuch a confuſion therein, that it is, as if it was entirely deſtroyed, which is a caſe very odd, and never taken notice of before.

Mr. *Derham*, conſulting what others had writ of magnets, he finds in *Grimaldi de lumine & colore*, that both he and M. *de la Hire* in *Phil. Tranſ.* N° 188. had hit upon the ſame diſcovery before him: Mr. *Derham* touched and coiled ſeveral iron-wires, but the effect that enſued was not ſuch as he before related; the verticity was indeed much weakened, but not totally deſtroyed, and the extremities of the wire would be attracted or repelled by the poles of the magnet; whereas, he had ſaid above, that they only were wont to be attracted; the next morning he tried again, and then the magnetiſm of the wires was entirely deſtroyed, as he related above; this experiment Mr. *Derham* repeated ſeveral times, and on ſeveral wires; and he commonly found, that all day, coiling will deſtroy the magnetiſm; but that

that it will not abſolutely do ſo in the evening; but whether it will have the ſame effect in ſummer, or in all ſeaſons, or whether it ſucceeds thus, only in different times of the day; Mr. *Derham* muſt leave to farther trials; he well knew that the orb of the activity of magnets is larger or leſs, at different times; that magnet in the Royal Society's repoſitory found in *Devonſhire* by Dr. *Cotton* is known in ſome weathers, or at ſome times to keep a key, or other piece of iron, ſuſpended to another iron at 8, 9, or 10 foot diſtance; but at other times, the iron will drop down at the diſtance of three or four feet from the magnet; now, whether at all, or how far this may reach the above-mentioned caſe, Mr. *Derham* cannot ſay, not having made a ſufficient trial of the matter: Mr. *Derham* tried the event of twiſting iron-wire from one extremity to the other, after it had been well touch'd; the ſucceſs of which was that the verticity was always weakened, and ſometimes inverted; and when it was ſo, the loadſtone commonly repelled or attracted, all one as if the twiſting the wire had given a new touch the contrary way; but in ſome wires ſo twiſted, the verticity was wholly deſtroyed, or rather much confuſed; for Mr. *Derham* found by drawing along one of the poles of the load-ſtone near the ſides of the wire, that in ſome places it would attract, in others repel, and ſo attract and repel all along the wire; nay, Mr. *Derham* fancied, that in ſome places, one ſide of the wire would be attracted, the other repelled by one and the ſame pole of the load-ſtone; theſe ſurpriſing chances do ſufficiently ſhew, that the magnetic virtue is put into great confuſion by the violence exerted upon the wire by twiſting, which not only ſeparates the fibres of the iron (as may be ſeen with the eye, but eſpecially, when aſſiſted with a microſcope but likewiſe changes their ſituation from lengthwiſe to ſcrew-wiſe: Mr. *Derham* then tried, what would be the iſſue of ſplitting or cleaving touched wires, particularly, whether they would exert the ſame effects, that magnets are ſaid to do, when ſawn in two meridianally; of which Dr. *Ridley*, in his *Treatiſe of magnetical Bodies and Motions*, Chap. 9. ſays; "Cut a piece from a magnet meridianally, and that extremity, which was placed ſouth, when it was whole, being ſevered, will turn north, tho' at firſt it was naturally the ſouth point." But Mr. *Barlow* is of a contrary opinion, and ſays, "That the poles of ſuch a piece of magnet, when ſevered, will abhor the ſame poles, to which it grew in the whole magnet;" but he ſubjoins in his *magnetical Advertiſements*, Ch. 2. "But here you muſt beware of an error, which ſome have fallen into, who obſerving the above-mention'd.

" diſcord, erroneouſly ſuppoſe, that, if both theſe magnets, the " larger and the ſmaller, *i. e.* the piece cut off, were conveniently " placed to ſwim in water, the ſmaller would not point with " its extremity to the ſouth pole of the earth, as it did in the " magnet when entire, and when it was a part of the true north " extremity, but would point contrarily; there is, ſays he, no " ſuch alteration; but that both the large and ſmall ones, and the " like, cut meridianally one from another will abſolutely point " the ſame way, which the entire ſtone did; only, the meridian " will be ſomewhat removed, *&c.*" Dr. *Gilbert* is as expreſs as Mr. *Barlow*, for, lib. 2. ch. 2. ſpeaking of a magnet divided, and ſhewing, how that the parts, which coaleſced in the entire ſtone, do by ſeparation repel each other, he ſays, " That what was the " north and ſouth pole before, is ſuch ſtill; for ſays he, the ver- " ticity is not changed, as *B. Porta* wrongly aſſerts; and tho' " the poles when divided do not incline to each other; yet both " are directed towards the ſame point of the horizon:" How the truth lies between Dr. *Ridley* and the two latter authors, Mr. *Derham* cannot determine, having never cut a magnet in that manner; but, by the magnetic laws, as well as from the authority of Dr. *Gilbert*, and Mr. *Barlow*, he does not doubt, but that the latter is the trueſt opinion: In cleft wires the caſe is very ſurpriſing; oftentimes the poles are quite changed; ſo that what was the north, becomes the ſouth pole of the wire in all reſpects; that is, not only turning, but alſo embracing, or avoiding the poles of the load-ſtone, as if it had received a new and contrary touch; ſometimes one half of the wire will retain its magnetiſm, which it had before ſplitting, and the other half have it quite changed; ſometimes no change at all will enſue, only the magnetiſm be much weakened; as, indeed, it always is in all the experiments, where the wire is ſplit; but generally, where one of the halves has ſuffered a change, and the other not, Mr. *Derham* obſerved, that it is the thinneſt and weakeſt that has been chang'd and the thickeſt that retained its touch; ſometimes, where one of the ſplit halves has received an inverted verticity, or ſeems to have no verticity at all, one of its extremities will incline to one of the poles of the magnet, not according to its touch, but in an inverted order, and the other extremity be attracted indifferently by both the poles of the load-ſtone; and in ſome caſes, that extremity ſhall be attracted by one pole, but be neither attracted nor repell'd by the other; but ſtand heſitating as it were, whether it had beſt fly to, or from that pole of the load-ſtone; only, if that pole of the

the magnet be too near, then that extremity of the wire will conſtantly fly thereto; as indeed, it is the nature of all magnets and magnetic bodies to do, when they touch or approach very near each other, tho' they repelled before; the cauſe of theſe great changes in touched wire produced by ſplitting, Mr. *Derham* has ſometimes imagined to ariſe from the violence exerted thereon by bending; but in ſome wires that he ſplit, with very little bending one half had been utterly changed, and the other not; in other wires he ſplit, by ſuffering the halves to bend as much as they would, no change has happened; and ſome others have ſuffered a total change; ſometimes Mr. *Derham* imagined, that the ſplitting the wires in a north or ſouth poſition, or beginning to ſplit at the north or ſouth extremity of the wire, firſt might be the cauſe of this contraverſion of the poles; but upon trials he found there was little in any of this; there is one thing very ſurpriſing in ſplit wire; *viz.* that the laying the one or the other ſide of the half uppermoſt, will cauſe a great alteration in its tendency, or averſion to the poles of the magnet, as he above obſerved; but upon laying the contrary ſide of that half uppermoſt, the extremity ſhall be attracted by one, and repelled by the other pole of the magnet; in other pieces, where the extremities are regularly attracted or repelled only in an inverted order, as if new touched, if it lay with the round ſide uppermoſt at that time, and be then turned upſide down, *viz.* the flat cleft ſide uppermoſt, it is ten to one, if one of the extremities be not either attracted by both the poles, or repelled by both; or elſe be attracted or repelled by one, and heſitate as to the other; for, ſo it often happens: The cauſe of this lubricity of the magnetiſm, Mr. *Derham* imagined, might be, becauſe, the ſides or edges of the wire had received contrary poles by ſplitting, and conſequently, were turned topſy-turvy, that what was the north might then be the ſouth edge of the half; but Mr. *Derham* could never diſcover, but that the ſides of each extremity, or of any other part were the ſame, when he held the load-ſtone to one or the other ſide; which he always did in every experiment for the greater certainty.

Mr. *Derham* tried the old experiment of touching wires, by rubbing them backwards and forwards with one of the poles of the loadſtone; Mr. *Barlow* was the firſt that diſcover'd the error of this way of touching; *viz.* that it weakens much, or hurts the touch; this Mr. *Derham* tried and found, that it is not only true, but likewiſe that the reaſon thereof, is, becauſe the poles of the wire, or needle ſo touch'd, are not at the extremi-

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ties, but in or near the middle of the wire or needle; ſometimes one is near the centre, the other at one or both extremities; for in ſome wires ſo touch'd, both its extremities would be attracted by one pole of the load ſtone, and repell'd by the other; and in ſuch a caſe the repelling pole always found a ſympathetic part near the center of the wire; in others (eſpecially, wherever the verticity ſucceeded, as ſometimes it will do, and that pretty ſtrongly too) the verticity would be inverted, and the extremities of the wire attracted and repell'd in a direct contrary manner to the natural form; the reaſon of all which will be manifeſt from theſe following experiments: Mr. *Derham* touch'd a wire from one extremity to the other, with only one pole of the magnent; this gave ſo vigorous a touch, that he is almoſt of opinion, it is the beſt way of touching; the conſequence was, that the extremity where he began, always turn'd contrary to the pole that touch'd it; he again touch'd the ſame wire, and others too with the pole of the magnet, from the ſame extremity, and then that extremity turn'd the contrary way; *e.g.* mark one extremity of a wire for the north, and touch that wire, by drawing the north pole of the magnet divers times along the wire from the north to the ſouth extremity; this wire ſo touch'd ſhall have a vigorous verticity, but the north extremity will ſtand ſouth; but if you touch that, or another wire (for it is all one, becauſe the latter deſtroys the former touch) by drawing the north pole of the magner from the ſouth to the north extremity of the wire, then this north extremity will turn north; and it will do the ſame, if you touch with the ſouth pole from the north to the ſouth: Mr. *Derham* further touch'd an iron wire exactly in the middle, with only one pole of the load-ſtone, without drawing it backwards or forwards; the event was, that in that place that pole of the wire was and the two extremities were the contrary pole of the wire, and were accordingly repell'd or attracted by the poles of the loadſtone; and the middle, and an inch or more on each ſide, was attracted only by the pole that touch'd it.

A Roman Inſcription; *by Mr.* Ralph Thoresby. Phil. Tranſ. N° 303. p. 2145.

A *Roman* monument was diſcover'd at *York* in digging a celler in *Coning Street*, not far from the *Roman* wall and *Multangular Tower*, deſcrib'd by Dr. *Liſter* in a former *Tranſaction*; this monument, dedicated to the *Genius* or tutelar deity of the place, is not of that coarſe rag, that generally the *Roman* monuments were made of, but of the finer grit, like the altar at the

the Lord *Fairfax*'s houſe in *York*; it is 21 inches long and 11 broad, inſcrib'd thus GENIO LOCI FELICITER: there was a larger ſtone found with it, but it had no inſcription; nor was there upon either of them the repreſentation of a ſerpent, or youthful viſage; by both which the ancients ſometimes repreſented theſe *Dii topici*: The author of this votive monument ſeems to have had the ſame ſuperſtitious veneration for the *Genius* of *York*, as thoſe at *Rome* had for theirs, whoſe names they were prohibited to utter, or inquire into; hence it is, that upon their coins the name of this deity is never expreſs'd, but in a more general manner by *Genius P. R.* or *Pop. Rom.* Mr. *Thoresby* had ſuch a coin of *Conſtantius*, minted at *London*, as appears by the *Exerg.* LON. under the effigies of that deity, with a *Patera* in the right hand, and *Cornucopia* in the left inſcrib'd GENIO POPULI ROMANI.

Mr. *Thoresby* inſtances in that of this Emperor (the father of *Conſtantine* the great) the rather becauſe he made *York* his Imperial ſeat, and was deified there; the medal of whoſe apotheoſis Mr. *Thoresby* alſo had, having been minted at the ſame place, and inſcrib'd MEMORIA FELIX; as the *Genius* of the city of *Rome* was expreſs'd by G. P. R. ſo was the *Genius* of the common-wealth from a moſt ſordid flattery, by that of the emperor, who they pretended to be their happy *Genius*; Mr. *Thoresby* had one even of *Nero*'s, not only after his *Quinquennium*, but alſo the year after he had laid moſt of the city in aſhes; yet by the expreſs order of the ſenate, inſcrib'd GENIO AUGUSTI. S. C; therefore ſome of the fathers have juſtly reproached the *Romans*, for paying a greater veneration to the *Genii* of their emperors, than to *Jupiter* their ſupreme God: This cuſtom of deifying the *Genii*, and that of aſſigning God for the defence of particular cities, is very ancient, as appears by what the Prophet *Jeremiah* ch. ii. v. 28 and xi. v. 13 ſays of revolting *Judah, according to the number of thy cities are thy Gods*; after the manner of the heathens, who according to *Varro* (*Pool's Synopſis Critic. in loc.*) had above 30000; and yet, notwithſtanding this prodigious number, it is evident from their medals, that ſeveral cities were ſometimes aſſign'd to the protection of the ſame tutelar deity; thus the *Greeks* (from whom the *Romans* receiv'd this, and ſeveral other of their ſuperſtitions) committed both *Magneſia* and *Smyrna* to the protection of *Cybele*; medals of the former are more common, than thoſe of the latter: Baron *Spanheim* has writ a learned diſcourſe upon them, one of which Mr. *Thoresby* had in his *Muſæum*, with the effigies of that mother

mother of the gods with her towered head, and CMYPNA; upon the reverſe was a lion paſſant, with CMYPNAIΩN; Mr. *Thoreſby* had alſo a large curious medal of *Julius Philippus*, that might induce us to believe, that *Antioch* was alſo devoted to the ſame *Cybele*; for it had round her head with the turreted crown ANTIOKEΩN MHTPOKOΛΩN with Δ (or rather Λ) E and SC on each ſide of the head: Mr. *Thoresby* was ſomewhat at a loſs about the meaning of the latter word, unleſs tſie *Greek* and *Roman* tongues began then to admit of a ſort of mongril mixture; ſo that from MHTHR and *Colonus* might proceed MHTPOKOΛ. ΩNΩN; and thus the *Antiochians* had the title of the men of the mother colony; the ΛE which are in *Greek*, and SC in *Latin* characters, the former ſignify *Luſtrum quintum*, the other *Senatus Conſulto*, ſeem to countenance this conjecture, the *Roman* S being different from that in ΦIΛIΠΠOC and CEBαστος upon the ſame coin. Mr. *Thoresby* had another medal of *Antoninus Pius*, inſcribed BEPOIAIΩN, mentioned *Acts* xvii. 2.

Roman Coins *near* Edlington *in* Yorkſhire; *by the Same.* Phil. Tranſ. N° 303. p. 2149.

THESE coins were dug up at the eaſt entrance of *Clifton*, a village on the cliff of the hill, three miles from *Doncaſter*, the *Roman Danum*, where the *Præfectus Equitum Criſpianorum*, reſided, and a mile from *Cunsburgh*, or *Coninsburgh*, an ancient ſeat of the kings during the *Saxon* heptarchy; they were found ſo near the high-way, that the cart-tracks had worn the earth off the top of the urn, wherein they were contained; upon digging farther, there was found another *Theca Nummaria*, which was full of copper coins as the former was; both the urns were large and entire; the larger one might contain about two gallons; by the fragments (the urns themſelves having been accidentally broken) they appeared to have been of a finer clay than thoſe found at *South Holland* in *Lincolnſhire*, and the coins were very well preſerved, by being in a dry ſoil; of 60 Mr. *Thoresby* had of thoſe found at *Fleet*, in the county of *Lincoln*, there was not one before *Gallienus*, nor after *Quintillus*; and of near 150 found at *Clifton*, there was not one of an older date; ſo that both thoſe in *Holland*, and thoſe in *Yorkſhire*, ſeem to have been hid in ſome common calamity, that followed the death of that ſhort liv'd emperor *Quintillus*, who reigned but 17 days, *A. D.* 271. And within ſix years after we find, that *Probus* the emperor, upon ſome commotions in *Britain*, ſent over ſome *Vandals* and *Burgundians*

gundians, who had invaded *Gaul*, to inhabit *Britain*; upon whose arrival, probably, ſuch as had made the inſurrection, might conceal their treaſure, and being ſlain in the conflict, it lay hid 'till now; this Mr. *Thoresby* looks upon as a more probable conjecture, than the perſecution of *Dioclesian*, which was not till 34 years after. The following capital letters are upon the coins, the reſt are only for explanation; the reverſes of *Gallienus*'s coins were, SECURITas PERPETua PAX AVGuſti APOLLINI CONſervatori AVGuſti PUDICitia. LAETITIA AEQUITAS AVG. AETERNITAS AVG.

LIBRro Patri CONS. AVG. DIANAE CONS. AUG. MARTI. PACIFERO . . . . . P. VII. COS. (*Pietas libans*) . . . . . S. STATOR, which Mr. *Thoresby* takes for *Mars*, who is ſometimes ſo ſtiled, as well as *Jupiter*. VICTORIA AETERna CONCORdia.

Reverſe of *Salonina Reverſa* VESTA.

Reverſe of *Poſthumus*, PAX. AVG. P. M. TRP. COS. V. which Mr. *Thoresby* takes to be remarkable not having met with any more than the fourth conſulſhip.

The reverſe of *Victorinus*, INVICTUS (*Typus Solis vel Apollinis*) VIRTUS AVG. PAX AVG. SALUS AVG. PIETAS AVG.

The reverſe of *Tetricus* the father, SALUS AUG. PAX AVG. HILARITAS AVG. VICTORIA AVG. FIDES MILITUM LAETITIA AVG. SPES PUBLICA COMES VIRTUS AVG. COMES AVG.

Reverſe of *Tetricus Cæſar*, SPES PUBLICA SPES AVGG. PIETAS AVGuſtorum.

Reverſe of *Claudius*, GENIUS EXERCI LIBERALITAS AVG. VIRTUS AVG. VICTORIA AVG. PAX AVG. FELICITas TEMPoris AEQVITAS AVG. JOVI VICTORIA.

Reverſe of *Quintillus*, PROVIDENTIA AVG. VIRTVS AVG.

Balls *voided by* Stool; *by Mr.* Ralph Thoresby. Phil. Tranſ. N° 304. p. 2164.

MADAM *C----ly* voided a ball, after ſuch ſevere pains, that her life was in danger; the bulk of it was much ſhort of another Mr. *Thoresby* had ſeen; and (as a

further inſtance of the danger of ſwallowing fruit-ſtones) ſhe immediately after, voided ſeveral plumb-ſtones, tho' ſhe had not for a twelvemonth before eat any of that fruit: Captain *Weſt* told Mr. *Thoresby*, that he had once ſeen two ſtones voided by one *William Coldel*, of *Green*, larger than any of thoſe three formerly mentioned in *Phil. Tranſ.* N° 281, 282; the ſmaller ſtone was ſomewhat larger than the biggeſt of thoſe, and the other was ſurprifingly large, being not much unlike the ſhape of the *Echinus* ſhell, or helmet-ſtone, flat on one ſide, and round on the other; it was above ſix inches in circumference one way, and ſeven the other; they weighed nine ounces, when firſt evacuated, and were removed by a diet-drink with an *Alcali* powder, and a magiſterial ſtomach-plaiſter; the perſon died ſeven years after, of a ball too large to be evacuated; and upon feeling it betwixt the *Hypocondrium* and ſhare-bone, it ſeemed to be as large as a gooſe-egg.

Several Experiments on the Attrition *of* Bodies in Vacuo, *and a Deſcription of a Machine for giving a ſwift Motion to Bodies* in Vacuo; *by Mr.* Hauksbee. Phil. Tranſ. N° 304. p. 2165.

A A Plate XIII. Fig. 11. repreſents a ladder, ſuch as is generally uſed in houſes; B B a bar of iron which paſſes thro' the middle of the upper ſtep, and is faſtened to the back-board of the ladder, by two nuts and ſcrews both thro' the board and iron; C C the jaws of the iron-frame, which holds the large wheel D D of 23 inches diameter within its groove; E E the braſs-plate of the air pump, on which the recipient *f f* is placed; *g g* the ſpindle to which bodies of different magnitudes may be faſtened, by a hole paſſing thro' their middle, ſufficient to receive their ſpindle; and by means of the two nuts *h h*, a larger or a ſmaller body may be ſcrewed faſt between them; *i i* a braſs-plate turned true to the ground edge of the recipient, whereon it is placed, having a braſs box in the middle of it, which is full of collars of leather well oiled, thro' which the ſpindle paſſes; the hole in the braſs being alſo exactly fitted to receive it; *k k* two pillars with nuts to ſcrew down a piece of board, which has an iron faſtened to it to receive the upper point of the ſpindle, the lower one falling into a braſs ſocket, ſcrewed to the middle of the plate of the air-pump; *l l* the ſupporters reaching from the upper-board of the ladder to the pillars, to prevent the repicient being drawn out of its place by the motion and tug of the wheel-band; *m m* the ſmall wheel which the band ſurrounds from the

large

large one, being one inch and a half in diameter; *n n* the winch which gives motion to the whole; the ſmall wheel *m m* making about 15 revolutions to one of the large wheel D D; ſo that a body faſtened to the ſpindle *g g* of the ſmall wheel *mm* muſt be turned 15 times round to one revolution of the large wheel; and according as it ſhall exceed the ſmall wheel in diameter, ſo will the velocity of the motion of the extreme parts be proportionably increaſed; *o o* are two ſcrews which faſten the ladder to the floor.

Exp. I. *Shewing that light is produceable upon a ſwift Attrition of Amber on woolen* in Vacuo.

Mr. *Hauksbee* being provided with the machine above deſcribed, for giving a ſwift motion to bodies *in Vacuo*, the amber made uſe of was beads, about the bigneſs of ſmall nutmegs, and threaded, by which means they were put upon a piece of wood, which he had cauſed to be turned on purpoſe, with a groove on the edge thereof, to keep the beads from being diſplaced upon a ſmart attrition; and likewiſe, between every bead there was a ſtring tied over from pin to pin, which were ſo many pieces of wire, drove thro' the wood for their better ſecurity, the beads appearing about half their diameter beyond the wood to which they were fixed, as repreſented in Fig. 12. In this manner it was put upon the ſpindle, and faſtened there by the two nuts, as above-deſcribed and as repreſented Fig. 13. Then the braſs-plate whereon the woolen was wrapt, being ſcrewed to its place (by means of the ſocket, which receives the lower extremity of the ſpindle) would then ſpring back, and lay hold of the amber with a moderate force, as in Fig. 13. Being thus prepared and the receiver placed over it, with its upper plate and box for the ſpindle to paſs thro', the pump was ſet on work, and in a very little time the mercury in the gage was elevated to about 29 inches and ½ which ſhewed that the recipient was well exhauſted; the large wheel being then turned gave a very ſwift attrition to the amber on the woolen, but there appeared no light at firſt; yet in a ſecond or two of time it became viſible enough, which ſhews that it requires ſome degrees of heat to produce the phænomenon; Mr. *Hauksbee* could not obſerve, that the continuance or increaſe of the motion, contributed any thing to the enhancement of the light, after its firſt production; nor would the light thus produced, live on the amber to continue a circle, notwithſtanding the velocity of the motion communicated; but died as ſoon as it had deſerted the fricated woolen; however the light continued

without intermiſſion, and was diſcernible at the diſtance of three or four foot upon the woolen during the motion, where the attrition of the amber was made; what was further obſervable, in this experiment was, that it very ſtrongly confirms thoſe made on the production of heat *in Vacuo* by attrition; for the amber was not only moderately heated, but appeared to be burnt and cracked by its intenſeneſs; and likewiſe the woolen againſt which it rubbed, not only appeared diſcoloured, but perfectly ſcorched and burnt thro'; that tho' the ſame motion and attrition was given the amber in the open air, yet very little light enſued, in compariſon of its appearance *in Vacuo*; that the velocity of the extreme parts of the amber, was equal to ſomething more than $\frac{1}{3}$ of a mile in a minute; ſuppoſing the large wheel, whoſe diameter is 23 inches, to make two revolutions in a ſecond of time; the diameter of the ſmall wheel moved by it one inch and $\frac{1}{2}$; and the diameter of the wood and amber on the ſame ſpindle with the ſmall wheel, four inches and $\frac{1}{2}$.

Exp. II. *Shewing the neceſſity of the preſence of the air, at leaſt ſome degree thereof, in the production of fire, upon the attrition of a flint and ſteel.*

Mr. *Hauksbee* having provided a ſteel ring about four inches diameter, and $\frac{1}{8}$ of an inch thick, which he fixed between two pieces of wood of a leſs diameter, on the ſpindle with the nuts, as mentioned in the foregoing experiment, its edge verging about $\frac{1}{2}$ an inch beyond the extremity of the wood, that held it; the braſs-plate, which he made uſe of for faſtening the woolen for the attrition of amber, ſerved likewiſe to fix a piece of flint, an edge of which ſtood expoſed to the ſteel, whilſt the braſs-plate by its ſpring held the flint pretty ſtrongly to it, notwithſtanding ſome might be worn or chipped off by the rapidity of the motion; in this manner it was covered with a receiver, a braſs-plate and box, as the former; but before any air was exhauſted, the large wheel was turned, which gave motion to the ſmall one, and conſequently to the included ſteel, which exhibited ſparks of fire in a very plentiful manner; after ſome air had been exhauſted, the large wheel was turned as before, but the number of ſparks then produced, did not only ſeem to be leſſened, but a ſenſible decay of their luſtre and vigour was evident; and ſo at every ſtop that was made, to repeat the experiment at greater rarefactions, the ſparks produced ſtill diminiſhed in their quantity and light; till at laſt, when the receiver had been well exhauſted, then tho' a more violent motion was given the ſteel than before, yet there did not appear the leaſt ſpark to be ſtruck from it; but a ſmall

a ſmall continued light was viſible on the edge of the flint, that was rubbed by the ſteel; upon admitting a little air, ſome ſparks upon the motion given, were diſcovered to be of a dull gloomy hue; but upon admitting a little more air, and by ſome accident the whole quantity being inſinuated, and then upon the repetition of the wheel's motion, the ſparks appeared as numerous and as vivid as at firſt.

Exp. III. *Shewing the production of a purple light, upon the attrition of glaſs on woolen* in Vacuo; *together with the various* Phænomena *of the ſame experiment at ſeveral trials*, &c.

The glaſs Mr. *Hauksbee* uſed in this experiment was globular, about four inches diameter, having a paſſage thro' the middle to receive the ſpindle, to which it was faſtened with corks and a ſcrew; the woolen againſt which it was to rub, was ſuch as is commonly ſold for gartering, the coarſer ſort of which Mr. *Hauksbee* choſe on purpoſe for its roughneſs, ſuppoſing it more likely to improve the phænomenon, than the liſt of cloth formerly uſed for the ſame purpoſe; this woolen was wrapped about the arm of the braſs-ſpring, deſcribed in the former experiments, and being ſcrewed down to its place, it gently embraced the glaſs globe; being thus prepared, and the large receiver put over all, the pump was wrought, and in a little time the receiver exhauſted; then the large wheel being turned, gave 15 revolutions to the included globe, to one revolution of its own; in which ſwift motion, rubbing on the above-mentioned woolen, a fine purple light enſued, the included *apparatus* being diſtinguiſhable by it, and continued ſo during the attrition; upon admitting a little air, both the light and its colour diminiſhed; and as the air was at ſeveral times permitted to re-enter the receiver, ſo the light became manifeſtly more pale, and leſs vivid; and even when the receiver was replete with air, a ſmall faint light diſcovered itſelf upon the ſame attrition given, as at firſt; what was farther obſervable in this experiment was, that the purple light which appeared, ſeemed to be about the breadth of ½ an inch, and about one inch high, being no where viſible, but on each arm of the braſs ſpring, where the glaſs in its motion rubbed on the woolen; and that the light remained ſteady, without the leaſt undulation, notwithſtanding the motion of the glaſs was conſiderably ſwift.

The firſt time Mr. *Hauksbee* made this experiment, its ſucceſs was much the ſame, as he has juſt now related; but when he came to repeat it twice or thrice, with the ſame glaſs, no purple light appeared, a pale one then ſucceeding in its room; nor could

could he by any means recover it, till he had taken a new glaſs, which after he had uſed for the ſame purpoſe two or three times, the ſucceſs was the ſame with the former, nor could it be revived again, without a new one; in this experiment, it was ſometimes obſervable, that the glaſs when taken out after a violent attrition would be ſo hot, as that a perſon could not hold it in his naked hands without a ſenſible offence; that the woolen on which it rubbed, appeared not only diſcoloured, but ſometimes perfectly burnt thro'; it would ſometimes happen in making this experiment, that a light would be carried quite round the glaſs globe, thereby forming a continued circle, during its motion, notwithſtanding it touched the woolen in no more places, than in the former experiments; at other times, a perfect halo would be ſeen round the ſtagnant light; which Mr. *Hauksbee* ſuppoſes, might have proceeded from ſome drops of water, that will ſometimes inſinuate by the ſpindle thro' the box, on the upper braſs-plate, where water was always kept, to prevent the admiſſion of any air; the water deſcending on the ſpindle till it reached ſome more extenſive part, would there by the violence of the motion given, be thrown about the receiver in ſmall drops, ſome of which were likely to fall on the woolen, where being heated by the motion of the above-mentioned glaſs, it evaporated, appearing like a halo around the light; for after Mr. *Hauksbee* made a contrivance, to prevent the ſcattering of the water, no ſuch appearance happened: Sometimes, Mr. *Hauksbee* obſerved the light to break from the agitated glaſs, in as ſurpriſing a form as lightning; particularly, when he uſed ſome liſt of cloth, that had been drenched in ſpirits of wine, and faſtened to one arm of the braſs-ſpring, and ſome of the ſame liſt that had been ſteeped in water, impregnated with ſalt-petre, tied on the other arm; but both pieces of liſt had been very well dried, before he made uſe of them: At another time, Mr. *Hauksbee* made uſe of two flat ſhells of oiſters well dried, inſtead of the woolen for the attrition of the glaſs, and each arm of the braſs ſpring had one fixed to it; upon the uſual motion given the glaſs *in Vacuo*, a light appeared reſembling a fierce flaming ſpark, juſt where the glaſs and ſhells touched each other; the light did not ſeem to extend itſelf, but was contained in a ſmall compaſs; he tried next, what would enſue upon the attrition of woolen on the above-mentioned ſhells *in Vacuo*, and the ſucceſs was, that a light was produced, but it appeared very dim and gloomy, at beſt like a faint halo: In order to try in what degree the woolen might contribute to the *Phænomena* in the foregoing experiments, Mr. *Hauksbee* took

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ſome of the above-mentioned liſt, and bound it about the edge of a wooden wheel he cauſed to be turned for that purpoſe; he faſtened as uſual, the wheel with its woolen edge, on the ſpindle, and the ſame gartering was made uſe of upon the braſs ſpring, as in the firſt experiment; theſe being put together (as in all the other expreiments) and the receiver exhauſted, the large wheel was turned, and upon the attrition of the woolen cloths, a ſmall glimmering light ſucceeded; but the continuance of the motion gave no encouragement to hope for any increaſe of it; Mr. *Hauksbee* expected to have found the woolen cloths at leaſt diſcoloured, upon their friction, which was ſometimes conſiderable; but on the contrary, there did not appear the leaſt ſign of any ſuch thing; the light entirely diſappeared, upon the re-admiſſion of leſs than $\frac{1}{4}$ of the recipient's natural contents of air, ſo the attritions then made was as great as it had been at any time before: Mr. *Hauksbee* could not diſcover, that the various colours of woolen, contributes any thing to the different colours of light, exhibited in any of theſe experiments.

Exp. IV. *Shewing the production of a conſiderable light, upon the attrition of glaſs on glaſs* in Vacuo *and in common air.*

In this experiment Mr. *Hauksbee* made uſe of a globular glaſs, about three inches diameter, fixed on the ſpindle, as in the laſt, and to the two arms of the braſs ſpring were tied two ſlips of thin board, to each of which were firſt faſtened two pieces of a glaſs-tube, by putting ſome ſmall nealed wires thro' their cavities; which wires likewiſe paſſing thro' ſome holes made in the board for that purpoſe, kept them tight in their places, as repreſented by Fig. 4. In this manner being covered with a large receiver, and fitted in all reſpects, as uſual, the pump was wrought, which in a little time had exhauſted the air therefrom; then upon turning the large wheel, a ſwift motion was given the included glaſs, whereby rubbing upon the above-mentioned tubes, a conſiderable light was exhibited; ſo that the whole included *apparatus* became perfectly diſtinguiſhable by it, and would have been much more ſo, had not the day-light prevented, it being then but very little after five P M. a clear horizon, and the experiment made in an open room; the colour of the light produced, reſembled melted glaſs, not only where the friction was made, but likewiſe ſeemingly at the extremities of the tubes A B where the globe in its motion did not touch them: What was further obſervable in this experiment was, that upon re-admitting the air into the recipient at ſeveral times, at each time a mo-

a motion being given, as at firſt, there appeared no ſenſible decay of light; till at laſt, when the tubes by much attrition were warm, and conſequently leſſened in their ſpring, the light (in proportion to the abatement of their force on the moving body) was diminiſhed; as Mr. *Hauksbee* had often obſerved, when the motion had been made for ſome ſmall time, only *in Vacuo*, or in common air; and had the experiment been begun, where it had finiſhed, a leſſer quantity of light (from the above-mentioned cauſe) would then have been exhibited *in Vacuo*; hence it follows, that the different mediums did no ways contribute to the augmentation or diminution of the light produced, but it ſeems to proceed entirely from the weakening of the ſpring, by the wear of the bodies, which is cauſed by the violent attrition of the one upon the other in either medium: Mr. *Hauksbee* did not find that the poliſh or glaze on the outſide of a glaſs, adds any thing to the light, having produced the ſame effect by a glaſs much worn by often uſing: Mr. *Hauksbee* repeated the ſame experiment in a clear day about noon; and the ſucceſs was that the light then produced *in Vacuo* was as ſenſible to the ſight, as a piece of red hot glaſs of the ſame bigneſs, would in the ſame time have appeared in the open air; but tho' the appearance is ſuch, it is no longer ſo, than the motion is continued; hence it is to be obſerved, that tho' it ſeems to be of the colour of red hot or melted glaſs, yet it is not really ſo; for if it were, it muſt of neceſſity outlive the motion ſome little time, which he could yet never diſcover in the darkeſt night.

Exp. V. *Shewing the production of light upon the attrition of glaſs on glaſs under water.*

This experiment was no more than a repetition of the laſt, ſaving only, that the included *apparatus* was entirely covered with water; from the ſurface of which when the air came to be exhauſted, and the large wheel turned as uſual, it was eaſy to diſcover a pretty briſk light, upon the firſt motion of the included glaſs globe on the tubes, illuminating the whole body of the water; the parts of the tubes, where the friction was made by the globe were diſtinguiſhably red; but they were ſoon leſſened in their appearance, and in a little time were extinguiſhed; the water by the continuance of the motion. approached nearer and nearer to the colour of whey, and at laſt became ſo thick, with the grit and powder produced by the attrition of the glaſſes, that the light could then be, but juſt diſcovered thro' its body, and that not conſtantly, but like faint flaſhes at a diſtance; Mr. *Hauksbee* had made this experiment, when it appeared more lumi-

luminous than it did at this trial; and he obſerved thro' a good microſcope the powder produced from the attrition of the glaſſes; but he could not diſcover with the greateſt attention, that the parts were any ways melted, only they appeared of a long ſlender figure.

A Puppy *that received no nouriſhment by the* Mouth; *by Mr.* Samuel Brady. Phil. Tranſ. N° 304. p. 2176.

THIS puppy was whelped at its full growth, having no appearance of a mouth at all, and it lived ſome time after it was littered; when the ſkin was pulled off the head, there did not appear the leaſt paſſage thro' it; the head was one entire ſolid bone, without ſutures, ſomewhat round like a man's ſcull, with a little prominence on the fore-part, reſembling the *Os naſi* of a man, but without any aperture; it had no place for eyes, nor *Meatus* for ears, only the outward reſemblance of one on each ſide, unpenetrated, and placed lower than naturally; there was no jaw-bone, nor conveyance to the top of the *Larynx* and *Pharynx*, but from thence downwards all was natural: This, Mr. *Brady* takes to be a confirmation, that the nouriſhment of the *Fœtus* in the *Uterus* is performed by the umbilical veſſels only, without the aſſiſtance of the mouth.

An Account of an extraordinary Sleepy Perſon; *by Dr.* Oliver. Phil. Tranſ. N° 304. p. 2177.

ONE *Samuel Chilton* of *Tinsbury* near *Bath*, a labouring man, about 25 years of age, of a robuſt habit of body, not fat, but fleſhy, and of a dark brown hair, happened on the 13th of *May* 1694, without any viſible cauſe, to fall into a very profound ſleep, out of which he could by no means be rouſed by thoſe about him, till after a month's time; when he roſe of himſelf, put on his cloaths, and went about his buſineſs of husbandry as uſual; he ſlept, eat, and drank as before, but did not ſpeak a word, till about a month after; all the time he ſlept, victuals and drink ſtood by him, which were ſpent every day, and as was ſuppoſed, by him, tho' no perſon ſaw him eat or drink all the while; from this time he remained free from any drowſineſs or ſleepineſs, till about the 9th of *April* 1696, when he fell into his ſleeping fit again, as he had done before; after ſome days his friends were prevailed on to try what effect medicines might have upon him; and accordingly, one Mr. *Gibbs* an apothecary bled, bliſtered, cupped, and ſcarified him, and uſed all the external irritating medicines he could think of; but all was to

no purpoſe; and after the firſt fortnight, he was never obſerved to open his eyes; victuals ſtood by him as before, which he eat of now and then; but no body ever ſaw him eat or evacuate, tho' he did both very regularly as he had occaſion; and ſometimes, they found him faſt aſleep with the pot in his hand in bed, and ſometimes with his mouth full of meat; in this manner he lay about 10 weeks, and then he could eat nothing at all; for his jaws ſeem'd to be ſet, and his teeth clinched ſo cloſe, that with all the art they uſed with inſtruments, they could not open his mouth, to put any thing into it to ſupport him; at laſt, obſerving a hole made in his teeth by holding his pipe in his mouth, they now and then, poured ſome tent into his throat thro' a quill; and this was all he took for ſix weeks and four days, and of that not above three pints or two quarts; he had made water but once, and never had a ſtool all that time: On the 7th of *Auguſt*, which was 17 weeks from the 9th *April*, when he began to ſleep, he awaked, put on his cloaths, and walked about the room, not knowing he had ſlept above a night; nor could he be perſuaded he had lain ſo long, 'till going out into the fields, he found every body buſy in getting in their harveſt; and he remember'd very well, when he fell aſleep, that they were ſowing their barley and oats, which he then ſaw ripe and fit to be cut down: There was one thing obſervable, that tho' his fleſh was ſomewhat waſted with lying ſo long a-bed, and faſting for above ſix weeks, yet a certain gentleman aſſured Dr. *Oliver*, that when he ſaw him, which was the firſt day of his coming abroad, he looked briſker than ever he ſaw him in his life before; and upon aſking him, whether the bed had made him ſore, he aſſured this gentleman, that he never found that, nor any other inconveniency at all; and that he had not the leaſt remembrance of any thing that paſſed, or was done to him all that while; ſo that he went again to his husbandry, as he was wont to do; and remained well from that time, till the 17th of *Auguſt* 1697, when in the morning he complained of a ſhivering and a coldneſs in his back; he vomited once or twice, and that ſame day he fell into his ſleeping fit again: Dr. *Oliver* going to ſee him, found him aſleep, with a cup of beer and a piece of bread and cheeſe, upon a ſtool by his bed, within his reach; the Dr. felt his pulſe, which at that time was very regular; and he alſo found his heart beat very regular too, and his breathing was eaſy and free; the Dr. only obſerved, that his pulſe beat a little too ſtrong; he was in a breathing ſweat, and had an agreeable warmth all over his body; then the Dr. put his mouth to his ear, and called him as loud as he could ſeveral times by his name, pulled

him

him by the ſhoulders, pinched his noſe, ſtopped his mouth and noſe together, as long as he could without choaking him, but to no purpoſe; for, all this time he did not give the leaſt ſign of his being ſenſible; the Dr. lifted up his eye-lids, and found his eye-balls drawn up under his eye-brows, and fixed without any motion at all; then the Dr. held under one noſtril, for a conſiderable time, a phial with ſpirit of *Sal Armoniac*, extracted from quick-lime; then he injected it ſeveral times up that ſame noſtril; and tho' he had poured into it about half an ounce of this fiery ſpirit, it only made his noſe run, and his eye-lids ſhiver and tremble a very little; the Dr. finding no ſucceſs with this, crammed that noſtril with powder of white hellebore, and ſtaying ſome time afterwards in the room, to ſee what effects all theſe together might have upon him; he never gave any ſign that he felt what the Dr. had done, nor diſcovered any manner of uneaſineſs, by ſtirring any one part of his body, that the Dr. could obſerve; and after all theſe experiments the Dr. left him, being pretty well ſatisfied, that he was really aſleep, and no ſullen counterfeit, as ſome people ſuppoſed: Upon the Dr's relating what he had obſerved, ſeveral gentlemen from *Bath* went out to ſee him, and found him in the ſame condition the Dr. had left him in the day before, only his noſe was inflamed and ſwelled very much, and his lips and the inſide of his right noſtril, was bliſtered and ſcabby, occaſioned by the ſpirit and the hellebore; about 10 days after the Dr. had been to ſee him, Mr. *Woolmer* an apothecary, finding his pulſe pretty high, drew about 14 ounces of blood from his arm, tied it again, and left him as he found him; and Mr. *Woolmer* aſſured the Dr. that he never made the leaſt motion in the world when he pricked him, nor all the while his arm was bleeding. Several other experiments were made by ſuch as went to ſee him from *Bath*, but all to no purpoſe: The Dr. ſaw him again the latter end of *September*, and found him juſt in the ſame poſture, lying in his bed; but now his pulſe was not ſo ſtrong, nor had he any ſweats, as when the Dr. ſaw him before; he tried him again, by ſtopping his noſe and mouth, but to no purpoſe; and a gentleman ran a large pin into his arm to the very bone, but he gave no ſigns of his being ſenſible of what was done to him; in all this time the Dr. was aſſured, that no body had ſeen him either eat or drink, tho' they endeavoured it as much as poſſible; but that it always ſtood by him, and they obſerved, that ſometimes once a day, at other times once in two days, all was gone; it was farther obſervable, that he never fouled his bed, but always went to the pot: In this manner he

lay till the 19th of *November*, when his mother hearing him make a noiſe, ran immediately up to him, and found him eating; ſhe aſked him, *How he did? Very well*, he ſaid, *thank God*; ſhe asked him again, *Which he liked beſt, bread and butter or bread and cheeſe?* He anſwered, *bread and cheeſe*; upon this the woman overjoyed left him, to acquaint his brother with it; and both coming ſtraight up into the chamber to diſcouſe him, they found him as faſt aſleep again as ever, and they could not by any means awake him; from this time, to the end of *January*, or the beginning of *Februaary*, he did not ſleep ſo profoundly as before; for when they called him by his name, he ſeemed to hear them, and become ſomewhat ſenſible, tho' he could not make them any anſwer; his eyes now were not ſhut ſo cloſe, and he had frequently great tremblings of his eye-lids, upon which they expected every day when he would awake, which did not happen 'till about the time mentioned; and then he awaked perfectly well, remembring nothing that happened all the while; it was obſerved, that he was very little altered in his fleſh, only he complained, that the cold pinched him more than uſual, and ſo he preſently went to husbandry, as at other times.

Some Roman Inſcriptions *found at* York; *by Mr.* Ralph Thoresby. Phil. Tranſ. N° 305. p. 2194.

THERE was found in *Trinity Yard* in *Mickle-gate*, at *York*, a funeral monument, upon which under the ſtatue (in *Baſſo Relievo*) of the ſtandard bearer of the 9th legion, was the following inſcription.

L. DVCCIVS
* *Lubens voluit* * L. VOTL. RVFI-
NVS VIEN
SIGNF. LEG. VIIII.
AN. XXIIX.
* *Hic ſitus eſt* * H. S. E.

This is an undeniable proof, that the 9th legion was not only in *Britain* in *Galba*'s time, and that it was alſo called *Hiſpanienſis* (as appears from Sir *Henry Saville*'s notes at the end of his edition of *Tacitus*) and likewiſe that it, as well as the 6th and the 10th legion, was called *Victrix*, and that it reſided at *York*, which had not been obſerved before; and yet both is evident, from the following inſcription upon a *Roman* brick found there.

LEG.

LEG. IX. VIC.

This is alſo an argument of the tranquillity theſe parts enjoy'd at that time (poſſibly the latter end of *Severus*'s reign) making bricks, caſting up highways, *&c.* being the uſual employment of ſoldiers at ſuch vacancies.

Sir *Henry Saville* was of opinion, that this *Nona Hiſpanienſis in Britania*, was one of thoſe eſtabliſhed by *Tiberius*, *Caius*, or *Claudius*, or perhaps, in the latter end of *Auguſtus*'s reign; but, however, that it was certainly here in *Nero*'s reign, and that *Pætilius Cerealis* was then lieutenant thereof, is indiſputably evident from *Tacitus* lib. XIV. cap. 10. who gives a lamentable account of the ſlaughter of 70000 citizens and confederates, by the enraged *Boadicea*, in which number was all the foot of this legion; *Cerealis* with the horſe hardly eſcaping; that this number is frequently writ by the *Romans* VIIII, as well as IX, one that is but competently verſed in their coins or inſcriptions, cannot but have obſerved inſtances of both kinds: Thoſe who have writ about the *Roman* legions, have ſaid nothing about the place of reſidence of this 9th legion; only, *Urſatus* in his book *De notis Roman.* remarks, that it muſt be ſomewhere in *Britain*, becauſe *Tacitus* tells us, that when the colony at *Camalodunum*, was deſtroyed by *Boadicea*, *Pætilius Cerealis*, legate of the 9th legion, came to their aſſiſtance; but yet, he makes no mention of its being ſtiled *Victrix*.

Obſervations *on the* Seeds *of ſeveral* Eaſt India Plants; *by M.* Leewenhoeck. Phil. Tranſ. N° 305. p. 2205.

THE *Euwane* is a tree in the *Eaſt Indies*, much about the bigneſs of an elder-tree, whoſe flower, ſcent, and figure are not very unlike it; but the branches are armed with thorns: It is uſed inwardly by none, excepting ſome women, who differing with their husbands, take it in order to kill themſelves, it being an infallible poiſon; when theſe women have taken ſuch a reſolution, they take half a handful of the leaves of that tree, and boiling them in water, they put to it a certain oil, which they call *Sinſelen*, and ſo they drink or eat it up; half an hour after which, they perceive a kind of convulſion in their head, and they vomit or retch four or five times; at laſt, they loſe their ſenſes, and foaming at the mouth, they fret and ſpeak like fools or madfolks, 'till they die; ſo that it ſeems, that the poiſon thickens the

the humours or fluid parts of the body, till their circulation quite ceaſes; ſome end their lives in one, others in two or three days, according as they have taken more or leſs of thoſe leaves: The ſeed of this tree is moſtly of a triangular figure, and where it is broadeſt it is not above the twelfth part of an inch; Mr. *Leewenhoeck* took a little of it, and putting it into a clean piece of paper, he bruiſed it with a hammer, and after that, he put it into a little glaſs phial, and poured ſome fair rain-water thereon, till it ſtood half an inch above the ſeed; after the ſeed had been infuſed in the ſaid water ſome hours, he took a little of the water and mixing it with ſome of his blood, he immediately obſerved, that the blood was very much coagulated; yea, more than he had ever ſeen it in his life-time; it is true, blood when mixed with common-water, retains its clear red colour, and a great many globules (which are the cauſe of its redneſs) being diſſolved in the water, do incorporate themſelves therewith, in ſuch a manner, that a perſon cannot diſtinguiſh any of them from the water itſelf, which thereby acquires a fine crimſon colour; yet, the appearance was quite otherwiſe with the blood that was mixed with the ſeed water; for, the particles or globules thereof being coagulated, aſſumed a blackiſh or dirty colour; and tho' he obſerved, a very great number of blood globules that had not coagulated, yet they lay like ſtiff particles; nor could he perceive, that any one of them was diſſolved or united to the water; ſo that there was not the leaſt redneſs, that looked like blood, communicated to the water, nor did there break forth the leaſt air-bubble out of this mixed liquor: M. *Leewenhoeck*, moreover, took a little of the ſaid water, that was inclinable to a reddiſh colour, and dropping it upon ſix ſeveral places of a glaſs-plate, in order to obſerve what ſalt particles might be coagulated therein; he obſerved, in the ſaid liqnor, moſt of which did evaporate, that, beſides the ſalt particles, there remained a great deal of a coagulated matter, wherein he could diſcover no figure; he likewiſe perceived, a great many exceeding ſmall particles, which were moſtly of an exact ſquare figure, and ſome few were oblong ſquares, with four right angles; ſome of theſe ſalt particles were broad in the middle, and pointed at both extremities; but where a great many of them were coagulated together, their figures were irregular; he likewiſe obſerved, that where the water had lain a little time together, it was not entirely exhaled, but left a balſamic matter behind it: M. *Leewenhoeck* put ſome of the *Euvane* ſeed into water, in order to ſoften the ſkin thereof, that he might diſſect it the more eaſily; and having accordingly opened ſeveral of them, he took

out

out the plant, in which tho' it was no bigger than a ſmall grain of ſand, he could perceive two leaves, and that part of it, which was to be the root and body of the tree: The oil of *Singelan* or *Singely* is eſteemed by the natives a good ſoftner, and given to women in child-bed, and to other perſons in pain, as alſo, to children, with or without any other ingredients; M. *Leewenhoeck* had a little of the ſeed of it, which is about the bigneſs of the *Euwane*-ſeed, but ſomewhat longer; he moreover, had ſome few ſeeds called *Canſie*; this ſeed is uſed by the *Mahometans*, after being ground ſmall and infuſed in water, and will intoxicate them, as much as wine does others; if a perſon that is not uſed to it, ſhould take but 10 or 20 grains, it would have the ſame effect as if he drank ten bottles of wine; they ſay, that it makes them very ſtout and luxurious; but ſuch as uſe it daily, and too often, bring themſelves at laſt to one or two ounces; but then it will have the quite contrary effect, rendering them dull and doating, depriving them both of their memory and appetite, and at laſt, making them ſo lean, as hardly to have any fleſh left upon their bones; and this is the uſe the *Mooriſh* kings make of it; for when they have a mind to be rid of ſome of their grandees, and would make them die a lingering death, they cauſe ſuch a drink to be made, into which they alſo infuſe the ſeeds of poppies, and give it them to drink twice a day, in priſon, more or leſs, according as they would have them diſpatched ſooner or later; inſomuch, that they ſhall live half a year or a whole year, without knowing any thing of the matter; they call this drink *Boſta:* This ſeed is little uſed by them in phyſic, tho' M. *Leewenhoeck* does not doubt, but that it might be well applied, becauſe, it does not only imitate the effects of *Opium*, but alſo, if there is not too much of it uſed at a time, it has the ſame operation, as the beſt wine: This ſeed is about the bigneſs of hemp-ſeed, and it has likewiſe ſuch another hard ſkin, ſo that one would be apt to take it for the ſame: M. *Leewenhoeck* took ſome of the *Canſie*; and ſtripping off the hard ſkin, and after that the thin membrane, that covers the plant, he obſerved, that the matter which lay within it, was as it appeared to him, nothing elſe but two leaves, together with the root and body of the plant; but upon ſeparating theſe two leaves, he found, that they involved two other very ſmall leaves, long and ſlender, and of the figure of the former; and he alſo diſcovered, that theſe ſmall leaves had each of them four or five other ſmall ones ſtanding out above each other; from hence he concluded, that the tree or plant, which produces theſe leaves, is notched or indented;

after-

afterwards, M. *Leewenhoeck* took ſome common hempſeed, and examining it a-new, to try whether he could diſcover any ſuch ſmall leaves, as he had found in the *Canſie*-ſeed, he obſerved, that all the parts of it agreed with the *Canſie*; at firſt, indeed, when he took the ſmall leaves out of the larger ones, wherein they were folded, he could not ſee thoſe indented parts above-mentioned; but, upon ſeparating the leaves from each other, he could eaſily perceive them; and then appeared the two exceeding long leaves, lying ſo regularly within each other, that the indented parts could not be diſcovered; he bruiſed a few of theſe little *Canſie*-ſeeds, and poured rain-water thereon, in order to diſcover whether there were any ſalt particles in the ſame, and tho' he let ſome of the drops of this water ſtand ſeveral days together, it did not at all evaporate, but there remained a thick oily moiſture, which he ſuppoſed was the reaſon he could diſcover ſo few ſalts coagulated; and thoſe he obſerved therein, were very few, and of the ſame figure with the ſalts found in wine vinegar.

River and Land Shells, *&c. found under Ground*; *by Mr.* Morton. Phil. Tranſ. N° 305. p. 2210.

UPON digging into a mooriſh paſture in *Mears Aſhby-field* in *Northamptonſhire*, there was found a few ſnail-ſhells of various kinds; about a foot deep they lay very thick, and digging downwards to about three foot deep their numbers increaſed; there were trials made for a conſiderable extent of ground, *viz.* about 250 foot in length, and 130 in breadth; beſides, the ſame ſhells were thrown up in ſeveral places by the moles: What was principally obſerved in this ſearch was; 1. A moiſt mooriſh black ſoil, in ſome places a foot and a half thick, in others ſomewhat above two foot; the lower half of it, was blacker and denſer than the upper half, of a bituminous nature, and having all the ſigns of peat-earth; beſides ſhells, there were found ſtalks, and leaves of graſs, as alſo ſeveral kinds of other vegetables depoſited, as is uſual, in the like bituminous moors, in other parts of this iſland. 2. A white ſoil, as was ſuppoſed at firſt; but upon a cloſer inſpection, it appeared to be nothing elſe than hay half waſted; as far as was dug into it, it was found every where copiouſly interſperſed with ſhells; upon finding theſe ſhells under ground, Mr. *Morton* diligently ſearched this place, in order to find ſome of the like ſpecies living upon the ſurface, but he could meet with none of any kind whatever there; ſome of the foſſile ſhells were the *Exuvia* of land-ſnails, the

the reſt of river or freſh water-ſnails; of the former there were the three following kinds. 1. A ſmall *Buccinum* of five wreaths, or the *Buccinum exiguum quinque anfractuum*, Tit. 7. Liſter in *Tractat. de Cochleis terreſtra. Anglic.* a kind which Dr. *Liſter* obſerved to live in moſs, upon old garden-walls at *Eſtrope* in *Lincolnſhire*; and Mr. *Morton* obſerved them at the moſſy roots of old trees in ſeveral of the *Northamptonſhire* woods, as alſo amongſt moſs upon the boggy ſides of ſeveral ſtanding ſprings. 2. A *Cochlea* of the compreſſed kind, but not ſo much compreſſed as ſome of them are; it had five wreaths, and a ſmall circular *Sinus* in the center; this, if it is not the *Cochlea umbilicata*, &c. N° 79. *Liſter. Hiſt. Conchyl.* lib. I. has not hitherto been mentioned by any author, tho' common enough in the woods in *Northamptonſhire*; Mr. *Morton* found a greater number of them (conſidering the compaſs of ground) incloſed in the earth, than ever he had done in any of the places, where they naturally breed. 3. The *Cochlea citrina.* Tit. 3. *Liſter de cochleis terreſtr. anglic.* or the common ſtriped ſnail-ſhell; but moſt of theſe in the moor were white, of the colour of the ſhells that have been dead a long time; Mr. *Morton* ſaw faint marks of their former ſtripes in ſome; moſt of the ſhells of this kind were lodged about four foot deep: He met with only two different kinds of river-ſhells. 1. A periwinkle-ſhell of three wreaths, generally leſs than the *Buccinum trium ſpirarum.* Tit. 24. *Liſter de cochleis fluviatil. anglic.* There was a greater number of theſe depoſited in the moor, than of any of the former kinds. 2. A periwinkle-ſhell of five wreaths, much ſmaller and more prominent than thoſe of the *Buccinum longum ſex ſpirarum.* Tit. 21. *Liſter de cochleis fluviatil.* It is otherwiſe very like that *Buccinum* in the ſhape of its wreaths, but it has not been deſcribed by any author; there are of this kind ſome live ſhells found, in one of the *Northamptonſhire* brooks, called the *Iſe:* The mooriſh ground, wherein theſe ſhells lay depoſited, extends from near the top to very near the foot of a hillock; upon the top and at the brow of this hillock, above the moor, there is a ſandy ſoil of a reddiſh colour; the whole ſurface of the moor is level, conformable to the reſt of the hillock, that is not moory, and of the ſame declivity with it, appearing to be in a natural and undiſturbed ſtate, as much ſo, as any of the glades in the neighbouring fields, excepting three or four trenches that have been cut thro' it.

It is evident, that theſe ſhells were left here at the general deluge, when thoſe from the ſea were alſo depoſited on land, and not lodged ſince under deterrations from the higher grounds; for

then the upper parts of the moor muſt have been covered with a reddiſh ſand, ſuch as the higher ground is for the moſt part compoſed of; yet, nothing like that appears near the ſhells in this moor; beſides, there are dug up here ſeveral ſhells, that in all likelihood never bred here, but were the inhabitants of a different ſoil; particularly, the ſtriped ſnail-ſhell; for theſe animals have peculiar ſoils, and affect particular regions.

A very large Tumour *in the Fore-part of the* Neck, *&c. by Dr.* James Douglas. Phil. Tranſ. N° 305. p. 2214.

DR. *Douglas* had the opportunity of opening a woman, about 50 years of age, who had a very large tumour, or hard ſwelling, on the fore-part of her neck, poſſeſſing all the ſpace between the whole extent of the lower jaw, and the upper part of the *Sternum*, with a conſiderable protuberance in its middle; laterally its point inclined to the left ſide, tho' the largeſt part of the tumour was on the right; the ſkin on the *Apex* of this protuberance was thin and ſhrivelled, of a different colour from the reſt, and looked as if the ſwelling would have broke in that place; the ſkin was exceeding thin, having no fat under it; only, in a cavity between two lobes, on its right ſide, there was a ſmall appearance of ſome fat; for the ſkin being leſs ſtretched there, the cells of the *Membrana adipoſa* were not quite emptied; the fleſhy fibres of the *Latiſſimus colli* were ſcarcely viſible; the *Maſtoidæus* and *Coraco hyoidæus* were exceeding thin, and in their aſcent they adhered very cloſely to the ſubjacent tumour; the *Sterno hyoidæus*, and the *Sterno thyroidæus*, that ran up the fore-part of this ſwelling, were diſtended ſo thin, that it was difficult to ſeparate them, eſpecially the latter, from it; the right carotid artery, in its aſcent to the head, run along its outer edge, which increaſing, did much obſtruct the current of the blood that way; the internal jugular, the *par Vagum*, and the intercoſtal pair, in their deſcent to the *Thorax*, paſſed alſo over ſome part of this ſwelling; two of the lymphatic glands of the jugular vein were ſwelled as big as little eggs, being placed at ſome diſtance from each other, with an intermediate cavity, where there was found ſome fat; theſe two lobes made the tumour alſo very irregular on its right ſide; theſe muſcles, the jugular, with the two glands adhering to it, and the reſt of the above-named veſſels being removed on both ſides, Dr. *Douglas* obſerved, that this preternatural tumour ſeem'd to exceed the bulk of two fiſts joined together; its figure was almoſt triangular, with a broad baſis under the chin, ſloping a little on each ſide, as it deſcended to the upper part of the *Sternum*,

Sternum, where its point was pretty narrow; its ſurface was made irregular by reaſon of three protuberances, of which the largeſt was turned to the left ſide, the other two being placed on the right, as was above obſerved; it adhered by membranous filaments to the maxillary glands, to the *Diagaſtric* and *Stylohyoidæus* muſcles, under which, on the right ſide, a ſmall portion of it in the ſhape of a nipple, intruded itſelf, as it were, under the tongue; in the upper and fore-part it alſo adhered to the *Os hyoides*; laterally it was connected with the *Levator ſcapulæ*, and lower down to that part of the *Cucullaris* that terminates in the clavicle; backwards to all the fore-part of the *Aſpera Arteria*, between its third or fourth cartilaginous rings, and the *Os pectoris*, as alſo to that muſcle of the head called *Rectus internus major*, and to ſome part of the *Scaleni*; its lower part was engaged under the *Jugulum*, or lunated part of the breaſt-bone, to which it adhered; it was eaſily ſeparated from its connections to all theſe different parts, but not ſo, from the *Glandulæ Thyreoidææ*, to which it adhered, after a very different manner; for where the thyroidal glands are joined to each other, a little below the *Cartilago cricoides*, on the fore-part of the *Aſpera Arteria*, there was no ſeparating it without cutting its ſubſtance; whence it plainly appears, that the union of theſe glands, was the origin of this exceſſive tumour; and yet, which was very remarkable, the glands themſelves kept their uſual figure, and were no larger than ordinary; this tumour was hard and very firm, being exactly of the conſiſtence of a cow's udder, when boiled; yet, in a few places it was ſoftiſh, containing a liquid and thick humour; its colour was chiefly of a whitiſh yellow, only in ſome places it was exceeding red, from its having a great number of blood veſſels therein, and in others it was very white: In cutting this tumour, the Dr. heard the edge of his knife grate againſt ſomething hard; wherefore, he carefully pared off all the ſoft part, and the hard ſubſtance that remained he boiled, and then cleared it very well, having left ſticking to it at one corner, a ſoft cartilaginous body, which poſſibly, had the patient lived longer, would have acquired the ſame degree of induration; it very much reſembled a piece of white unpoliſhed rock-cryſtal; but whether it might be reckoned oſſeous, or whether it was rather the viſcid humour of the glands hardened and concreted into this irregular chalky or gravelly ſubſtance, or whatever elſe it might be, the Dr. leaves it to others to determine: Dr. *Douglas* found in the *Proſtatæ* of a very old man, a great many hard bodies, like white peaſe, of a ſubſtance exactly reſembling this, only it was ſmoother on the outſide;

ſome of theſe were in the body of the ſaid glands, and others adhered by ſmall roots to the muſcular membrane, that inveſts them: The firſt appearance of this large ſwelling, was about 20 years before, occaſioned by the breaking of a vein, as the patient uſed to expreſs it, in a hard and very difficult labour; it increas'd but very ſlowly, not having arrived to any conſiderable bulk, 'till a few years before ſhe died; it was never very painful, being a true *Schirrus*; ſeveral things had been applied unſucceſsfully; its bigneſs became at length very troubleſome, impeding her ſwallowing and free breathing, and at laſt it quite choaked her, by compreſſing the wind-pipe, upon which it lay; but beſides this, the Dr. obſerved another remarkable accident, which much haſtened her end, being very painful and troubleſome for a year or two before ſhe died; the *Uterus* was entirely ſchirrhous and diſtended to that degree, that it filled up the whole cavity of the *Pelvis*; part of the *Colon* and *Ileum* adhered ſo cloſely to it, that there could be no ſeparation without tearing; both the *Ovaria* and *Tubæ* grew cloſe to it; and indeed, the confuſion and mixture of all theſe parts were ſo great, that if the *Ovaria* had not been ſwelled here and there with hydatidal tumours, he could not have diſtinguiſhed them; the neck of the *Uterus* was preſſed down ſo low, that upon a very gentle dilatation of the *Labia*, it offered itſelf to view, being exceeding hard, but yet ſmooth and regular, and ſo cloſely ſhut, that the Dr. could paſs nothing without cutting; it had ſqueezed the *Veſica urinaria* ſo cloſe againſt the *Os pubis*, that it could contain little or no urine, which obliged her to make it often, and that with pain; the preſſure of this part backwads was ſo great upon the *Inteſtinum rectum*, that the evacuation of the fæces had been obſtructed for the ſpace of five weeks before ſhe died; the *Fæces alvinæ* contained in the guts were but few, by reaſon ſhe could not ſwallow any thing ſolid for a long time, and they were very hard, and in ſeveral diſtinct clots; there was obſerved to come away *per Anum*, for ſome conſiderable time, a great deal of *Pus* and ſlimy matter, but that proceeded from the *Uterus*; for, the acrimonious humour, which was wont to be diſcharged *per Vaginam*, having been pent up within its cavity, by the cloſe conſtriction of the *Collum Uteri*, had corroded and eat its way thro' the ſubſtance of the *Uterus* into the *Rectum*, by which it was diſcharged; and this caſe Dr. *Douglas* has frequently obſerved in diſſections; the thickneſs of the *Uterus* was near two inches, and in its bottom there was a great deal of this humour, white and thick, which made the extremities of his fingers white and rough, ſhrivelling the *Cuticula*, as

if

if he had waſhed them with a ſtrong ſolution of ſome acrid lixivial ſalt, and as happens to thoſe who waſh linen, from the cauſtic ſalt lodged in ſoap affecting their hands; it was very difficult to take the *Uterus* out of the *Pelvis*, by reaſon of its very cloſe adhefion to the neighbouring parts.

A Glade *of* Light *obſerved in the Heavens*; *by Mr.* Derham. Phil. Tranſ. N° 305. p. 2220.

AS Mr. *Derham* was obſerving the immerſions of the third and fourth ſatellites of *Saturn* on the 20th of *March* 1706 in the evening, he obſerved a very ſurpriſing ſort of light, in the conſtellation of *Taurus*, the lower extremity of which was below the bull's eye, and the other a good way above it, and that ſtar about the middle of the lower extremity thereof; repreſented its appearance in Plate XIII. Fig. 16. this glade of light had the ſame motion, that the heavens had, and was much like the tail of a comet, but pointed at the upper extremity, as ſhewn in the Fig. Mr. *Derham* does not doubt, but that this light is ſuch as Dr. *Childrey* firſt obſerved in *England*, and which *Caſſini* and others afterwards, obſerved in *France*, as Dr. *Hook* ſays.

The Proportion of the Weight of Air, *to the Weight of a like bulk of* Water, *without knowing the Quantity of either*; *by Mr.* Hauksbee. Phil. Tranſ. N° 305. p. 2221.

MR. *Hauksbee* having cauſed to be made a bottle ſomewhat of an oval figure, on purpoſe, that it might librate the more eaſily in water, that held upwards of three gallons; he put into this bottle as much lead as would ſink it under the ſurface of the water, and it was, when weighed in that medium, ballanced by a ſmall weight in the ſcale on the other extremity of the beam; Mr. *Hauksbee* included the weight, to prevent the inconveniency of bubbles of air, which he was aware would plentifully adhere to, and lurk in the irregular body of the weight, had it been fixed on the outſide; being thus provided, and the bottle cloſed with common air, it was ſuſpended by a wire at one extremity of a very good balance, and being in the water, it was counterpoiſed by a weight of 385 grains and $\frac{1}{2}$ in the oppoſite ſcale; being then taken out and ſcrewed to the pump, it was in five minutes pretty well exhauſted, the mercury in the gage being elevated to near 29 inches and $\frac{1}{2}$; it was then taken off the pump; but firſt, by turning a cock that ſcrewed both to it and the pump, the air was prevented from returning into it; in this manner it

was

was put again into the water, and ſuſpended as before on the balance, and it then weighed but 175 grains and ½, which ſubſtracted from the firſt weight, gave 183 grains the difference, and [illegible]as the weight of the quantity of air exhauſted from the [illegible] the pump; then opening a cock under water, the water [illegible]t violently impelled into the bottle (but gradually abat-[illegible]e) till ſuch a quantity had entered, as was equal to [illegible]air exhauſted; ſo that by making the experiment [illegible]r, one need not be very ſollicitous in the nice exhauſtion [illegible]receiver; for it muſt anſwer reciprocally to the reſpe[illegible]ntities exhauſted, the remaining air being weighed at laſt, as well as at firſt; and no greater quantity of water could enter the receiver, than what would ſupply the ſpace deſerted by ſo much air; the bottle being now weighed again, it was found to be 162132 grains, from which ſubſtracting 175 grains and ½ (which is the exceſs of the weight of the bottle, above its like bulk of water) there remained 161956 grains and ½, which being divided by 183 grains, the weight of the air exhauſted from the receiver, gave the proportion as 885 to 1, the *Avoirdupoiſe* weights being brought to ounces, he reduced them to grains, by multiplying by 438, the preciſe number of grains contained, in an ounce of that weight; the column of mercury in the barometer was elevated at the ſame time to 29. 7 inches; this experiment was made in *May*, and Mr. *Hauksbee* does not doubt, but if it is repeated in *December* or *January*, there will enſue a ſenſible difference.

An Experiment, *ſhewing that the ſeemingly ſpontaneous aſcent of Water in ſmall Tubes, open at both extremities, is the ſame* in Vacuo, *as in the open* Air; *by the Same.* Phil. Tranſ. N° 305. p. 2223.

MR. *Hauksbee* took three pieces of ſmall tubes of different bores, and fixed them directly perpendicular in a piece of cork, with their lower orifices as exactly level as poſſible; he alſo faſtened this cork to a wire, which paſſed thro' ſome collars of leather, included in a box on the upper plate of the receiver; by which means, he could at pleaſure elevate or depreſs the tubes, without any danger of the air inſinuating itſelf; being thus prepared, and tinged water being put on the plate, the ſmall tubes, which had never been wetted, were drawn to the upper part of the receiver by the above-mentioned wire; and when the air was exhauſted, the tubes were made to deſcend by the ſame wire, till their lower extremities were juſt plunged under the ſurface of the tinged

tinged liquor, upon which the water roſe immediately in each of them, to a conſiderable height above its ſurface in the glaſs, and higher in the ſmaller tubes than in the larger ones, and would retain the quantity that ſpontaneouſly aroſe in them, notwithſtanding their lower orifices were drawn out of the water; upon admitting the air again, they continued juſt the ſame as *in Vacuo*; Mr. *Hauksbee* found, that by plunging tubes of ſeveral ſizes in the tinged liquor, ſo much of it would remain ſuſpended in them, when taken out of the liquor, as in ſuch tubes, when plunged, was elevated above the ſurface of the ſtagnant fluid; he likewiſe obſerved, that upon bending ſome ſmall tubes, into the ſhape of ſyphons, by the flame of a candle, the orifice of the longer leg muſt be at leaſt ſo far below the ſurface of the ſtagnant water, as that water in the ſame tube would ſpontaneouſly aſcend therein, before it would run out.

A Roman Sudatory *found at* Wroxeter *in* Shropſhire; *by Mr.* Thomas Liſter. Phil. Tranſ. N° 306. p. 2226.

ABOUT 40 perches north of a ruinous wall, called the *Old-work* of *Wroxeter* (once *Uriconium*, a famous city in *Shropſhire*) in a piece of arable land, a ſmall ſquare parcel thereof was obſerved to be barren, and not to be improved by the beſt manure, tho' theſe fields had formerly been made very fertile by the flames and ruins of the city; upon digging, there were diſcovered ſeveral bottoms of old walls (as are often found in thoſe fields) in one of which, to the weſtern corner of the ſaid unfruitful ſpot of land, there was found a little door-place, which led into a ſquare room, walled round, and floored under and over, with ſome aſhes and earth therein: This as ſome ſuppoſe, was built in former times for a *Hypcauſtum*, ſudatory or ſweating houſe for *Roman* ſoldiers, with four rows of ſmall brick pillars, eight inches ſquare, laid in a ſtrong ſort of very fine red clay, each pillar being founded upon a foot ſquare quarry of brick, and upon the head of each pillar was fixed a large quarry of two foot ſquare, almoſt as hard as flint, (as moſt of thoſe *Roman* bricks are) and within as red as ſcarlet, and as fine as chalk; theſe pillars were to ſupport a double floor, made of very ſtrong mortar, mixed with coarſe gravel, and bruiſed or broken bricks; the firſt of theſe floors was laid upon the large quarries, and when dry, the ſecond floor was laid over that; but firſt there was a range of tunnel-bricks, faſtened with iron cramps up to the wall within, having their lower extremities level with the under ſides of the broad quarries, and their upper ends level with

with the ſurface of the upper floor; and each tunnel had two oppoſite mortice-holes alike, one on each ſide, cut thro' for a croſs paſſage to diſtribute the heat amongſt them all.

Wroxeter was one of the moſt conſiderable military ſtations or colonies the *Romans* had in this iſland; the city wall, as appears from a ſurvey taken of it by Mr. *Liſter*, was not much leſs than three miles in circumference; and it is not improbable, but that it was founded by *Suetonius Paulinus*, or after, by *Agricola*, in their march to ſubdue *Mona*, now *Angleſey*; *vide* Baxter's *Gloſſarium Antiquitatum Britannicarum*: Sir *Chriſtopher Wren* diſcovered the remains of ſuch another *Hypocauſtum*, as that near *Wroxeter*, when they were laying the foundation of the king's houſe at *Wincheſter*; Mr. *Hunter* gave an account Phil. Tranſ. N° 278. of an antiquity of this kind dug up in *Yorkſhire*; Mr. *Lhwyd* in his additions to *Cambden* takes notice of another diſcovered at *Kaerhyn* in *Caernarvonſhire*; and in the table of curioſities added at the end of the *Welſh* counties, N° 8. repreſents one of the hollow bricks or tunnels; Mr. *Cambden* himſelf mentions an *Hypocauſtum* diſcovered at *Hope* in *Flintſhire* in his *Britannia*. p. 688.

The Hypocauſta *of the Ancients*; *by Mr.* Baxter. Phil. Tranſ. N° 306. p. 2232.

THE ancients had two ſorts of *Hypocauſta*; the one called by *Cicero*, *Vaporarium*, and by others, *Laconicum* or *Sudatio*, which was a large ſweating-bath, in which there were *tria Vaſaria ahenea*, called *Caldarium*, *Tepidarium* & *Frigidarium*, from the water contained in them; the other ſort of *Hypocauſtum* is not ſo diſtinctly handled by antiquaries; it was a ſort of a fornax, or kiln to warm their winter-parlours, or *Cænatiunculæ hybernæ*, *erat* & *Diæta*, *ſive Cænatiuncula*, ſays *Argol* upon *Panvinius*, *ſub quâ ignis accendebatur*, *unde* & *Cænatio Hypocauſtum*; the *Cænationes æſtivæ* & *hybernæ* are mentioned by *Cicero* in his epiſtles; the terrace floor is called by *Vitruvius*, *Teſtudo*; *Teſtudines Alveorum in communi Hypocauſi caleſacientur*, ſays the ſame author; this *Hypocauſis* was called *Alveus* & *Fornax*; and the perſon that tended the fire *Fornacator*; the *Tubuli* ſeem to have been contrived to convey away the ſmother, that otherwiſe would choak the *Fornacator*; this kind of ſtove ſeems to be graphically deſcribed by *P. Statius in Balneo Hetruſci*.

Ubi

——*Ubi languidus ignis inerrat*
Ædibus, & tenuem volvunt Hypocauſta vaporem.

Of the terrace, *Argol* has theſe words, *Teſtudines ſunt Pavimenta ſub quibus Fornax ardet*; and by the bye, Mr. *Baxter* takes the word ſtove to be derived from *æſtus, quaſi æſtuvium.*

The Jaundice *occaſioned by a* Stone *obſtructing the* Ductus communis bilarius, *which was afterwards voided by Stool; by Dr.* William Muſgrave. Phil. Tranſ. N° 306. p. 2233.

MR. *Harvey* voided a ſtone by ſtool, which he ſaid came from the *Ductus communis bilarius*; the figure of this ſtone was oval, almoſt an inch long, and its ſhorteſt diameter $\frac{7}{10}$ of an inch; it weighed 59 grains, when Dr. *Muſgrave* ſaw it; but at its coming away it was above a drachm in weight, ſome part thereof being rubbed off by frequent handling; its ſurface was rough, unequal, and divided into ſeveral little eminencies, each ſomewhat leſs than the ſize of half a vetch: The ſeveral ſtrong annular fibres, which appear not only at the orifice, where the *Ductus communis* opens into the *Duodenum*; but alſo all along the oblique paſſage (which according to Dr. *Gliſſon* is about half an inch long) of that duct, between the coats of the inteſtine, do by way of ſphincter, keep this extremity of the *Ductus communis* very ſtrait and cloſe; and beſides this ſtraitneſs of the duct, the two oblique inſertions it makes at ſome diſtance from each other, thro' the two outer coats of the *Duodenum*, render it ſtill more difficult, for a ſubſtance of any bulk, to paſs this way; ſo that, however large the ſtones may be that are generated in the gall-bladder, *Ductus cyſticus*, *hepaticus* or *communis*, it is not eaſy to conceive, how a ſtone of the magnitude here deſcribed, could poſſibly thro' a paſſage of itſelf ſo very narrow, ſtrait and difficult, be conveyed into the *Duodenum*: To prove that this ſtone was not formed in the alimentary duct, but (large as it was) had come into it from the *Ductus communis*, Mr. *Harvey* told Dr. *Muſgrave*, that before the diſcharge of this ſtone, he had had the jaundice, which came ſuddenly upon him, and continued ſeveral months, in a ſevere and moſt exceſſive manner; that this jaundice, beſides the diſcolouring of his urine and ſkin, to a very great degree, and beſides loſs of appetite, faintneſs, and ſeveral other ſymptoms, uſual in this diſtemper, was alſo accompanied with a pain in, or near the ſtomach; that during this jaundice, his ſtools were of a white colour, as

having very little or no mixture of choler in them; that, going (under theſe circumſtances, eſpecially, with a continual pain, as before-mentioned) in his coach from *London* to *Clifton*, and ſoon after to the *Bath*, he found a little after his arrival there, that this ſtone came away by ſtool, and together with it, almoſt a ſpoonful of gravelly matter, and a conſiderable quantity of choler, as appeared from the yellowneſs of his ſtools; all which happened ſo ſoon after he came to the *Bath*, as plainly to prove, that the diſcharge both of the choler and ſtone, proceeded from the motion of the coach; that his deliverance from the jaundice, commenced from the time of the expulſion of this ſtone; for ſoon after that, the colour of his ſkin and urine, and indeed, all the bad ſymptoms diſappeared; and in a very little time (weakneſs only excepted) he recovered.

All theſe things put together, make a conſiderable argument, that the orifice of the *Ductus communis* (how ſtrait and how ſtrong ſoever) was ſo far dilated in Mr. *Harvey*, as to give way to the ſtone, here deſcribed; that is, dilated to a circle $\frac{7}{10}$ of an inch in diameter, and one inch and $\frac{3}{4}$ in circumference: The jaundice is often obſerved to be a moſt ſtubborn diſtemper, not eaſily yielding to the moſt probable methods, and often to none at all; *Riverius* poſitively affirms, that when it proceeds from a ſtone obſtructing the current of the choler, it is incurable, urging this reaſon for his opinion; *Calculus, cum diſſolvi non poſſit, morbum facit incurabilem Cap. de Ictero*: When the jaundice is thus difficult of cure, eſpecially, when there is a probability (whether from a pain fixed in, or near the region of the liver, or from any other good argument whatſoever) that it ariſes from the cauſe now mentioned; it may not be amiſs, to adviſe exerciſe on horſeback, in coach, or any other ſuch way, as ſhall be likely to diſlodge the ſtone, and bring it off; but to make this exerciſe effectual, it ought to be as violent, as the patient can well bear; and in ſuch a manner, as may by much agitation of the body, be moſt conducive to the deſigned cure; the account here mentioned, does ſufficiently recommend this gymnaſtic courſe, as capable of relieving, in ſome caſes of the jaundice, when the beſt methods of phyſic (for ſuch no doubt Mr. *Harvey* had preſcribed himſelf) fail of ſucceſs.

An Eruption of Water *in* Craven; *by Mr.* Ralph Thoresby. Phil. Tranſ. N° 306. p. 2236.

MR. *Thoresby* having further enquired of a certain perſon who was an eye-witneſs of an extraordinary eruption of water in *Craven*, of which there is an account in Phil. Tranſ. N° 245, was not only ſatisfied of the truth of the relation, but alſo, that a great part of the land ſtill lay under ſand and ſtones, tho' a great many had been employed to remove them; upon the opening of the rock, at the foot of which the town of *Starbotham* ſtands, the water guſhed out in ſo vaſt a quantity, as if it would have ſwept the whole town away; the waves came rolling down upon each other; ſeveral houſes were quite ruined, and others up to the chamber-windows; one in particular was covered in ſuch a manner, that a large piece of the rock was left upon the top of the chimney.

Obſervations *of the ſolar* Eclipſe May 12 1706 *at the* Royal Obſervatory *at* Greenwich, *&c. by Mr.* Flamſtead. Phil. Tranſ. N° 306. p. 2237.

THE morning was cloudy and moiſt, till about eight o'clock, when the clouds began to break, and the ſun was ſometimes ſeen thro' the intermediate ſpaces, a ſeven foot teleſcope was fitted up with a ſcene to receive the ſpecies of the ſun, on which he appeared about ſeven inches diameter, divided into digits by ſix concentric circles; but clouds intervening, the ſun frequently rendered this way of obſerving inconvenient, and therefore laying aſide the *apparatus* of the ſcene, Mr. *Flamſtead* viewed him thro' the ſame teleſcope with ſmoak glaſſes, and obſerved,

1706 *May* 1ſt St. N. MANE	Time correct. by the pendulum clock.	
	h. ′ ″	
	8 21 30	A very ſmall part of the ſun's diameter was eclipſed.
		The chord of the arch of the ′ ″
	28 00	ſun's periphery eclipſed was 14 40
		Then followed frequent clouds in the intermediate ſpaces; then ſome zenith diſtances of the ſun were taken for cor-

1706 *May* 1st St. N. MANE	Time correct. by the pendulum clock. h.	′	″		′	″
				recting the clock, and afterwards, when near the middle of the eclipſe.		
	9	21	46	The parts of the diameter remaining clear	5	00
		26	20		4	30
				Frequent large clouds again till the ſun appeared thro' the		
	10	31	50	breaks, and the eclipſe was not ended, clouds again, till		
	10	33	50	when the ſun ſhone out again his limb was ſeen entire, and the eclipſe certainly over.		

At *Canterbury* Mr. *Stephen Gray* had prepared a ſcene placed behind his ſeven foot glaſs; ſo that the ſpecies of the ſun projected thereon was ſeven inches over, but having the ſame ſort of weather at *Canterbury*, as at *Greenwich*, he did not ſee the beginning of the eclipſe, by reaſon of clouds; but he obſerved other phaſes and the end of the eclipſe, as follows,

Cor. time by the pendulum Clock. h.	′	
8	53	5 digits and ⅓ darkened
9	08	— 7
	31	— 10 or more
	36	— the ſun ſhining for a ſhort time, the eclipſe ſeemed to decreaſe
	55	— 7 ½ a little clearer
	57	— 6 ¾
10	02	— 6
	4	— 5 ¾
	14	— 4
	16	— 3 ¾
	20	— 2 ½

Cor.

Cor. time by the pendulum clock.		
h.	′	
	30	— 1
	31	— 0 ¾
10	36 ½	— the end of the eclipſe accurately obſerved with a 16 foot teleſcope.

At *Horton* near *Bradford* in *Yorkſhire*, Mr. *Abraham Sharp* projected the ſpecies of the ſun on a ſcene-plate, behind his ſeven foot glaſs, ſo that it appeared ſeven inches over; by reaſon of cloudy weather, he ſaw neither the beginning nor end, but other phaſes near the middle of the eclipſe, as follows

Time corr. by the Pend. clock.			
h.	′	″	
8	35	00 — 3	} digits dark by ocular eſtimation.
9	01	00 — 7	}
	4	54 — 8 ⅒	eclipſed on the ſcene
	6	33 — 8 ½	
	7	53 — 8 ⅖	
	12	50 — 9	
	16	08 — 9 ⅖	
	18	48 — 9 ½	exactly, the ſun ſhining out clear
	20	45 — 9 ½	the ſun ſtill ſhining clearly; greateſt obſcurity
	21	48 — 9 ½	ſtill clear
	28	46 — 9	
	44	45 — 7	
	54	42 — 5 ¼	
10	06	10 3 ½	digits
	19	55 — 2	preciſely
	24	00 —	the ſun ſeen thro' clouds, the eclipſe not ended
	30	00 —	the ſun ſeen again perfectly round and entire.

At *Bern* in *Switzerland* captain *Stannyan* obſerved, that the ſun was totally eclipſed for four minutes and ½ of time; that a fixed ſtar and a planet appeared very bright; and that his getting out of the eclipſe was preceeded by a blood red ſtreak of light from its left limb, which continued no longer than ſix or ſeven ſeconds

ſeconds of time; then part of the ſun's diſk appeared all of a ſudden, brighter than ever *Venus* was ſeen in the night, and in that very inſtant gave a light and ſhadow to things, as ſtrong as moon light uſes to do.

Captain *Stannyan* is the firſt that ever obſerved a red ſtreak of light preceeding the emerſion of the ſun's body from a total eclipſe, which is the more remarkable as it infers, that the moon has an atmoſphere, and its ſhort continuance of only ſix or ſeven ſeconds of time, ſhews us, that its height is no more than the five or ſix hundredth part of her diameter.

Obſervations on the Sun's Eclipſe; *by M.* Facio Duillier. Phil. Tranſ. N° 306. p. 2241.

THERE was a total eclipſe of the ſun obſerved at *Geneva* on the 12th of *May* 1706, N. S. a little after the ſun's riſing, the ſky ſeemed clear, tho' the air was already thick with ſome vapours; ſeveral little clouds afterwards aroſe here and there, and the vapours increaſed much; for want of a pendulum-clock, in a convenient place, the moment of the total immerſion, the moment of the firſt emerſion, and that of the end of the eclipſe, could not be accurately obſerved; tho' the ſky was ſomewhat overcaſt, the heat of the ſun was already felt, when the eclipſe began; but a very ſenſible cold was felt, as the moon by degrees covered a greater and greater part of the ſun, and as the light decreaſed, the eclipſe was obſerved, only with ſome glaſſes, either darkened with ſmoke, or but a little tranſparent; and by receiving the ſpecies of the ſun, thro' a ſix foot teleſcope, which inverted the objects, upon a piece of white paper, placed at ſome diſtance from the eye-glaſs, when the ſun was near being totally dark, the bright creſcent, which remained, was ſeen to diminiſh more and more upon the paper; and when that creſcent was reduced to a very narrow breadth, and to a very little length, it was ſeen to diſappear of a ſudden; and in that moment the whole ſun was eclipſed; at the ſame inſtant of time, the darkneſs which was already very conſiderable, became much greater; the clouds changed their colour of a ſudden, and became red, and then of a pale violet; there was ſeen, during the whole time of the total immerſion, a whiteneſs, which ſeemed to break out, from behind the moon, and encompaſs it equally on all ſides; this whiteneſs was but little determined on its outward ſide, and was not ſo broad as the twelfth part of the diameter of the moon; this planet appeared very black, and her diſk was very well defined, within the whiteneſs, which encompaſſed

paſſed it about; and whoſe colour was the ſame, with that of a white crown or halo, of about four or five degrees in diameter, which accompanied it, and had the moon for its center; *Venus* was ſeen at the ſame time, at ſome diſtance without that crown, between the eaſt and north-eaſt in reſpect of the ſun; *Saturn* and *Mercury* were alſo ſeen by ſeveral, eaſtwards from the ſun's place; and had the ſky been clear, ſeveral other ſtars might be obſerved, as alſo *Jupiter* and *Mars*, that towards the eaſt, and this towards the weſt; and ſo the ſeven planets might have been ſeen, almoſt all at once; and accordingly, ſome in the country had told more than 16 ſtars; and ſeveral people, who were on the neighbouring mountains, ſaw the ſky ſtarry, in ſome places where it was not overcaſt, as if it were in the night in time of the full moon; the total immerſion began about $\frac{3}{4}$ paſt 9; the duration of the total darkneſs was preciſely three minutes, or 180 ſeconds, to the moment that the firſt ray of the ſun began to appear again, with great brightneſs; and this time was obſerved with a ſimple pendulum, which was afterwards compared with a pendulum clock, vibrating ſeconds, and regulated on the mean motion of the ſun; a little before the total obſcuration, one could neither read nor write; and ſome ſwallows were ſeen amazed looking for a reſting place, and ſeveral bats flying out; in other places hens and pidgeons made haſte to their rooſts and habitations; a little after the ſun had beg n to appear again, the whiteneſs and the crown, that encompaſſed the moon, entirely vaniſhed; then the ſun ſhewed himſelf more and more, at firſt appearing like a little creſcent, which ſtill increaſed, and whoſe concave ſide ſeemed to be terminated, by an arch; a little before the total obſcuration, the country on the weſt ſide, already ſeemed to be overcaſt with darkneſs; and after the total obſcuration, the darkneſs was ſeen to leave us more and more and fly eaſtwards: According to M. *Gautier's* obſervations, from the firſt emerſion of the ſun, to the end of the eclipſe, was 1 h. 9′ 30″; as to the accurate times they were uncertain, the pendulum-clock having been ſet only by a ſmall ſun-dial.

According to obſervations made on the eclipſe of the ſun at *Marſeilles*, in the Jeſuits obſervatory of St. *Croix*, by M. *Chazelles* and Father *Laval*.

	h	′	″
The eclipſe began at	8	28	40
Reached the ſun's center at	9	6	11
			Total

	h.	′	″
Total at	9	34	15
The ſun began to appear again at	9	37	9
The eclipſe came again to the center at	10	12	23
It entirely ended at	10	47	50

Three ſtars were diſtinctly ſeen, and for three minutes one could not ſee to read; and their remained one bright digit, all round the body of the moon.

The latitude of the manor-houſe of *Duillier*, is 46° 24′, its longitude is 4° 13′ 45″ to the eaſtward of the royal obſervatory at *Paris*; and St. *Peter*'s church at *Geneva* is in latitude 0° 12′ to the ſouthward, and in longitude 0° 5′ 2″ to the weſtward of *Duillier*.

According to theſe obſervations, the altitude of the moon's atmoſphere cannot well be ſuppoſed leſs than 130 miles of perpendicular height, of which 60 make one degree of the earth; nor could that atmoſphere be diſcovered, before the time of this eclipſe, by any refraction of the ſtars; probably, becauſe of the ſmallneſs thereof, and for want of proper obſervations; and tho' it was very plain, that the atmoſphere of the moon muſt needs ſhew itſelf in the time of a total eclipſe of the ſun, yet no body thought of it, till now, that ſeveral perſons actually ſaw it: Some obſervations evince, that our atmoſphere is ſomethimes viſible, all along from the ſurface of the earth to the perpendicular height of one ſemi-diameter of the terreſtrial globe and the continued appearance of a crown, of only four or five degrees in diameter, about the ſun, during the whole time of the total obſcuration, ſhews, that the æthereal matter, in which that crown was produced muſt be at a conſiderable height above the ſurface of the earth; but, if that crown was to be ſeen, ſo far as the weather permitted, in all the places, where the eclipſe was total, it muſt be concluded, that the cauſe of it was not in our air, but in ſome vapours encompaſſing the ſun; and probably, in thoſe very vapours, which produce that pointed light, that had been obſerved lying in a manner along the ecliptic, and had the ſun for its center: If ever ſuch another appearance ſhould be ſeen in the time of a total eclipſe, it would be proper to obſerve accurately the leaſt diameter of the crown from inſide to inſide; and whether during the whole time of the total immerſion, the inward circle be every where continued, and of an uniform figure; the leſs the ſaid diameter, and the greater the exceſs of the moon's apparent diameter above that of the ſun, as alſo,

the

he greater the apparent altitude of the ſun is above the horizon, the higher the cauſe, which produces the crown, muſt be above the ſurface of the earth; and the poſition, upon the moon's diſk, in reference to the zenith of the points of contact, where the ſun diſappears, or begins to ſhew itſelf again, is here alſo of ſome conſideration.

An Account of the ſame Eclipſe; *by Dr.* Scheuchzer. Phil. Tranſ. N° 306. p. 2246. *Tranſlated from the* Latin.

AT *Zurich* in *Switzerland*, on the 12th of *May* we had a total and annular eclipſe of the ſun; total, becauſe the whole diſk of the ſun was covered by the moon; but not properly annular, only ſo by refraction, ſeeing there appeared about the moon a blood-red ſtreak of light, ariſing from the refraction of the rays in the moon's atmoſphere.

	h.	′
The Beginning of the eclipſe was in the morning at	8	54
The middle at	9	58
The End at	11	12

The *Mora* of the mean and entire obſcuration was 4′, at which time both the fixed ſtars and planets were ſeen, the birds betook themſelves to their neſts, the bats began to fly about, and the fiſh to ſwim in the waters; there was felt at *Zurich* a ſenſible cold, and there fell a dew upon the ground.

END of the FOURTH VOLUME.

THE

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CORRIGENDA.

PAGE 143. line 4. for abſciſion *r.* abſciſſion. *P.* 179. *l.* 31. for ᾳ *r.* ᾱ ibid. *l.* 34. for ζωρικον *r.* σωρικον, and for χαλκιον *r.* χιλιον. *P.* 180. *l.* 28. for oppoſuit *r.* appoſuit. *P.* 187. *l.* 21 for flag *r.* ſlag. ibid. *l.* 29, for ſequunter *r.* ſequuntur. *P.* 188. *l.* 17. for itenerary. *r.* itinerary. ibid. *l.* 20. for vicinnalis. *r.* vicinalis. *P.* 263. *l.* 21. for Latino-Germanico *r.* Latino Germanica. ibid *l.* 22. for vitœ *r.* vita. *P.* 384. *l.* 31. for capitijs *r.* capitis. ibid. *l.* antipenult. for Μιξον' *r.* Μιζον'. ibid *l.* penult. for πυριακμι βαλε *r.* πυριακμβαλε. ibid *l.* ult. for ευριτε *r.* εὔρητε. *P.* 386. *l.* 8. for Celatoria *r.* Colatoria. ibid. *l.* 20. for Cheſhire *r.* Cheſter. *P.* 396. *l.* 4. for meliorus *r.* melioris. *P.* 399. *l.* 19. for Parhelion *r.* Perihelion. *P.* 408. *l.* ult. for Fabricus *r.* Fabricius. *P.* 409. *l* 9. for Blanchini *r.* Bianchini. *P.* 461. *l.* ult. for criſis *r.* craſis.

FINIS.

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